Nursing Home Bed Supply and Medicare Inpatient Utilization: 1981-86

May 1992

Submitted to:

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Chapter 1

Introduction

The relationship between the availability of nursing home beds and the use of hospital care is usually thought of in terms of the additional hospital days required by elderly patients who are unable to secure nursing home placement at the time when they are ready for discharge. So-called Administratively Necessary Days (ANDs) have become a special concern for hospitals since the inception of the Prospective Payment System for Medicare inpatient stays. A series of papers have documented a negative relationship between both ANDs and average length of hospital stay by Medicare beneficiaries and the number of nursing home beds per elderly person in the vicinity of the hospital. This result suggests fairly clearly that increases in the number of nursing home beds in a locality, at least within some range, can be expected to reduce the demand for days of hospital care by elderly patients already admitted to the hospital. That nursing homes might actually reduce hospital admissions is far less clear. There is evidence that nursing home residents may be somewhat less likely to be admitted to the hospital than community residents of the same health status. Even if true, this result could have little effect on the overall hospital admission rate of the elderly since only about five percent of this population is estimated to reside in nursing homes. Whether increased availability of nursing home beds might actually reduce hospital admissions of elders residing in the community depends on the degree to which nursing home care can substitute, at least at the margin, for hospital care.

This paper investigates the empirical relationship between the density of Medicare or Medicaid-certified nursing home beds in U.S. counties and the rate of hospital admissions among aged Part A Medicare beneficiaries residing in those counties. Increases in nursing home beds do appear to reduce hospital admission rates in this population. The magnitude of the estimated effect, however, is highly sensitive to the manner in which the composition of beds is specified. That is, skilled nursing facility (SNF) beds that are not jointly certified for Medicaid intermediate care facility (ICF) care appear to reduce the demand for Medicare admissions much more strongly than those that are jointly certified.

Chapter 2

The Substitution of Hospital for Nursing Home Care

Introduction

To address properly the issue of substitutability of nursing home care for hospital care, it is first necessary to distinguish categories of Medicare beneficiaries for whom the potential substitution might be observed. We consider three categories of beneficiary, defined by their current location: 1) those currently hospitalized, 2) those currently residing in a nursing home, and 3) those currently residing in the community. These categories help to identify mechanisms by which this substitution could occur and point to the need to specify appropriate measures of this hypothesized substitution.

In order to clarify ideas at the outset, we shall formulate the fundamental issue of substitution as follows: Does increased access to nursing home care reduce the observed consumption of selected measures of hospital care by aged Medicare beneficiaries, and if so to what degree? Because substantial portions of nursing home and hospital care are funded by third parties, the typical economist's measure of substitution, involving Hicks-Allen cross elasticities of demand, is of little use. The term "access", while admittedly vague, is used here to replace price as a measure of the ease with which individuals can obtain care in a nursing home. Increased access will be defined as reductions in barriers to use of nursing homes or as decreases in the length of queues for nursing home admission.

Substitution by Currently Hospitalized Patients

For hospitalized patients, the focus of research is naturally on the potential for nursing-home and other forms of long-term care to reduce the duration of inpatient stays by providing the elements of subacute care similar to those the patient would have received in the final days of a hospital stay.[1] Most work has emphasized delays in discharge caused by the inability of some patients to secure placement in a nursing home, termed Administratively Necessary Days or ANDs. Numerous studies demonstrated that a significant number of hospital days are provided to elderly patients who no longer require acute care but were not transferred to more appropriate rehabilitative or chronic care facilities (Glass et. al. 1977; Shapiro et. al. 1987). Portnoi (1979) may have been the first to argue that many ANDs result from an undersupply of long-term care beds which in turn produces a queue of hospital patients awaiting placement in nursing homes.

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[1] We do not distinguish here between patients hospitalized from a nursing home and those hospitalized from the community since, by definition, both are seeking nursing home care subsequent to discharge.

The Medicare Prospective Payment System (PPS), implemented nationally in 1983, created strong new incentives for hospitals to discharge Medicare patients as soon as possible. Delays in discharge caused by the inability of some patients to secure placement in a nursing home became a special concern for hospitals by the mid 1980s. If nursing home care can substitute effectively for the final days of a hospital stay for a significant fraction of Medicare patients, then hospitals located in areas where nursing home placement is particularly difficult (due to a low ratio of nursing home beds to elderly residents or perhaps to especially restrictive Medicaid policies) are placed at a disadvantage relative to hospitals located in areas where placement is easier.

Empirical investigations have tended to accept the premise of substitutability of nursing home for some portions of hospital stays and have focused instead on the magnitude of the AND problem and on the importance of supply factors versus other causes of placement delays. Gruenberg and Willemain (1982) analyzed a 1976 survey of hospital discharge delays conducted by the Massachusetts Department of Public Health. They found strong evidence that nursing homes avoided "difficult" patients. Among patients newly available for discharge, the mean duration to nursing home placement among those who were not Medicaid recipients (or Medicaid recipients who were admitted from a nursing home and who were continent) was slightly less than half that of Medicaid recipients admitted from the community or Medicaid recipients who were incontinent (6.2 days vs. 13.4 days).[2] They also found waiting times for discharge to nursing homes to be positively correlated with local nursing home occupancy rates. Gruenberg and Willemain argue that expansion of the supply of nursing home beds alone cannot be expected to ameliorate the problem. " . . . The sharply different mean waiting times for different types of patients suggest that it would take a very large increase in bed supply to reduce the AD [administrative days] problem significantly. Whatever improvement in access would occur is likely to benefit those whose access is already best (p.199)." They fail to develop this argument, however, and do not consider the extent to which the limited supply of beds allows providers to reject undesirable patients so readily.

A more recent series of papers has established a convincing link between nursing home beds per capita in particular areas and both ANDs (as estimated by hospital administrators) and the average length of Medicare hospital stays. Holahan and Dubay (1988) found a statistically significant negative relationship between hospital discharge planners' estimates of ANDs, as reported to the Government Accounting Office (GAO) in 1985, and the number of nursing home beds per 1000 elderly in each hospital's own market area. The composition of beds, measured alternatively as the

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[2] Weissert and Cready (1988) have argued that the distinction between Medicaid recipients and non-recipients is overstated. They found that *uncertain* Medicaid status (having applied for but not yet been approved for Medicaid) played a much more important role in generating discharge delays in the Charlotte, North Carolina area.

proportion of SNF beds or the proportion of Medicare-certified beds in the total had no significant effects on ANDs. In a similar study, Kenney and Holahan (1990), aggregated length of stay to the hospital level for 16 distinct DRG categories, using Medicare hospital claims data (MEDPAR) for 1985. They found statistically significant negative relationships between the number of certified nursing home beds per 1000 elderly in the hospital market area (defined as the hospital's 3-digit ZIP code) and mean PPS length of stay, percentage of stays that were "long stays", and the proportion of stays that qualified as PPS outliers. Implied elasticities of the three variables with respect to nursing home beds per 1000 elderly were -0.07, -0.13, and -0.26 respectively. Hence a ten percent increase in the number of nursing home beds in a hospital's market area, holding elderly population constant, is predicted to reduce the mean length of PPS-covered hospital stays by 0.7 percent. The low elasticities are expected, the authors note, because the fraction of Medicare beneficiaries discharged to nursing homes is itself relatively low.

Substitution by Nursing Home Residents

Are residents of nursing homes more or less likely to be admitted to a hospital than otherwise similar individuals who reside in the community? On the basis of introspection alone, it is fairly easy to argue either case. Nursing homes provide a greater intensity of care and monitoring to residents than is usually available to frail elderly people living in the community. Quicker access to caregivers who are more highly trained than the family members who provide most care to community residents may increase, however slightly, the threshold at which a given nursing home resident's physician recommends hospital admission. A longer period of "watchful waiting" would be expected to reduce the admission rate somewhat since the conditions of at least some residents could be expected to abate. Nursing home residents near death may also be hospitalized less frequently than terminally ill community residents.

It is also possible, however, that this same increased observation of nursing home residents could result in earlier detection of conditions requiring hospitalization than they would occur in the community. The literature examining the link between nursing home and hospital care, while quite sparse, suggests that nursing homes tend to reduce the probability of hospitalization. All conclusions are highly qualified, however, because of the difficulty in properly controlling for the health status of individuals.

McMillan et. al. (1987) examined inpatient hospital expenditures for a sample of joint Medicare/Medicaid eligible individuals residing in California, Georgia, New York and Tennessee. Among those who died in 1981, inpatient expenditures were somewhat lower for nursing home residents than for community residents, particularly among the very old. They conjecture that "It

is likely that some of the aged who are terminally ill and living in the community are hospitalized for palliative treatment while similar terminally ill patients residing in nursing homes can be equally well cared for in the nursing home (p.11)." Notice that the occurrence of death acts as a crude adjustment for patient condition in this analysis. Beneficiaries who died in a given year are almost surely more homogeneous in terms of health than are beneficiaries who survived the year. Thus while survivors who resided in nursing homes incurred greater inpatient expenditures than survivors who resided in the community, no useful inferences can be drawn from the result.

Shapiro et. al. (1987) estimated the probability of hospitalization for community residents in the Manitoba Longitudinal Study on Aging, using age, sex, and mortality as covariates. They used these probabilities to compute the expected number of hospitalizations from a sample of long-term nursing home residents and a sample of individuals recently admitted to a nursing home in Manitoba. Observed hospital admissions were lower than expected admissions in most age-duration cells and were significantly lower than expected admissions when all cells were combined.[3] The authors conclude that institutional long-term care significantly reduces the rate of hospitalization, relative to the level that would be observed for the residents were they to remain in the community.

Finally, Goldstein et. al. (1984) compared costs and outcomes for all nursing home residents admitted to an intensive/coronary care unit (ICU/CCU) at the Massachusetts General Hospital with both community residents over 65 years old receiving home care and with other over-65 individuals admitted to the same ICU/CCU. Nursing home residents were found to be no more or less likely to be admitted to an ICU than the general population aged 65 and over. The authors' speculation echoes that of McMillan et. al.: "Since nursing home residents carry a high burden of chronic illness, it is quite possible that a great many acute events develop in them that would ordinarily prompt ICU/CCU admission. The patient and physician may on the basis of personal or ethical grounds elect treatment in a less intensive setting, either in the nursing home or on the general medical floor of the hospital rather than in an ICU/CCU (p.859)."

The indications that residence in a nursing home in and of itself reduces the likelihood and intensity of hospital use are hardly definitive. Nevertheless, when health status is controlled for, in however crude a fashion, the available evidence points to this conclusion.

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[3] Cells were defined by age, duration of stay in nursing home and by period or observation for hospital admission.

Substitution by Community Residents

When we speak of substitution of nursing home care for hospital care by individuals who *currently* reside in the community, we are referring to the possibility that increased access to nursing homes could reduce demand for hospital admissions by the free-living elderly since effects on length of stay were already treated above. On *a priori* grounds, opportunities for substitution of this sort would appear to be rare. Only in communities where the availability of nursing home beds is severely limited would one expect to find elderly individuals admitted to hospitals for care that might appropriately be provided by a nursing home. Studies of the relationship between nursing home bed supply and hospital use of community residents have not been conducted. In a study of the effects of PPS on hospital utilization, Schmitz (1988) estimated a negative relationship between nursing home beds per capita and the Medicare hospital admission rate (and the 30-day rehospitalization rate) using data aggregated to the BEAA level for 1981.[4] His counts of nursing home beds were of uncertain veracity, however, and were not reported for the same year as were the Medicare hospital admissions.

[4] BEAAs are Department of Commerce, Bureau of Economic Analysis Areas. These are collections of contiguous counties defined by urban centers of economic activity. They were designed to represent coherent market areas to the greatest extent possible.

Chapter 3

Aspects of the Nursing Home Market

Introduction

Before proceeding to estimate the relationship between nursing home beds and Medicare hospital use, it is worthwhile to examine the nature of the supply of and demand for nursing home beds in some detail. A careful treatment of the subject is especially appropriate in view of the stated purpose of this investigation. Studies of this sort, including those by Kenny and Holahan (1990) and Holahan et. al. (1989), generally must assume, at least implicitly, that the observed variation in the number of nursing home beds per elderly individual are largely the result of variations in supply conditions.[5] The assumption is required in order to allow one to argue that bed availability is predominantly a determinant rather than a consequence of consumer behavior. This chapter does not attempt a complete analysis of the operation of the nursing home market; such an analysis would require an examination of the mechanisms of supply and demand for nursing home care and of the way in which state rule-making and state program requirements (such as Certificate-of-Need [CON] and Medicaid eligibility and coverage policy) impinge on these mechanisms. Some discussion of the market is required, nevertheless, in order to frame the statistical hypotheses to be tested here and also to understand the nature of the frequently alleged undersupply of nursing home beds.

Supply and Demand in the Nursing Home Market

The supply of nursing home beds, like the supply of housing units or cargo ships, but unlike the supply of restaurant meals or symphony performances, has capital-like elements since the current stock represents the accumulation of past net increments to the total quantity and can be augmented in the short run only at high cost. The decision of suppliers to increase or decrease the stock of beds in the current period is contingent on an array of factors affecting both the cost of additional beds and the current and expected future rates of payment per bed-day by government and private payers. Of particular importance to individual suppliers are both the level of state reimbursement for nursing home care provided under Medicaid and the legislative restrictions, which vary widely from state to state, governing the addition of nursing home capacity. At any given instant then, the supply of beds is fixed, since additional beds cannot be quickly added in response to changes in economic con-

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[5] As stated, the assumption is overly strict. What is required is the ability to "hold constant" those factors that lead to variations in demand. The age structure of the elderly population, for example, is highly correlated with the number of nursing home beds per person aged 65 and over. Failure to account for this aspect of demand will tend to bias estimates of the effect of beds on hospital utilization.

ditions; the short-run supply curve of beds or bed-days in a locality may be regarded as vertical. This fixed stock also represents a current-period **equilibrium** quantity resulting from a series of past decisions to increase or decrease the number of beds. Hence a continuing high level of demand for nursing home care in an area is likely to produce, **ceteris paribus**, high current-period numbers of beds per capita in that area.[6]

Conventional supply and demand models fail to account for some of the commonly- observed characteristics of the nursing home market. The most prominent of these characteristics are 1) the existence of two prices for a nursing home bed day in most facilities - a private pay rate for residents not eligible for Medicaid and a Medicaid rate (determined by a state rate-setting methodology) for Medicaid recipients, 2) the conversion of some private-pay patients to Medicaid status via spend-down of assets and income, and 3) the widely-reported presence of queues for admission to many homes. Standard competitive models usually do not permit an equilibrium in which two prices are observed for the same good or service. Rather, they predict that one of two things will occur to destroy this equilibrium: either Medicaid patients will not receive care or the private-pay price will be bid down to the Medicaid rate.[7] Non-competitive models in which nursing homes possess a degree of market power enabling them to set private-pay rates rather than take them as given by the market have therefore become attractive as a means of rationalizing observed behavior.

Scanlon's (1980) model of the nursing home market is commonly invoked to explain the persistence of multiple prices and queues in the nursing home market. Following an approach developed by Sloan and Steinwald (1975) and others, Scanlon viewed nursing home operators as facing a downward-sloping demand curve for care by private-pay residents and a perfectly elastic demand for care by patients eligible for Medicaid coverage. Profit-maximizing operators therefore behave as price discriminating monopolists and set private rates so as to equalize marginal revenue from private-pay patients to Medicaid prices.[8] The model is illustrated in Figure 3.1. Private demand

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[6] This result is not because high demand produces high supply but because persistent high demand produces a higher equilibrium quantity, <u>ceteris paribus</u>. Insistence on the distinction between the supply of beds and the observed quantity may appear pedantic, but helps to prevent hasty assertions based on improper terminology. For example, the observation of a correlation between hospital beds per capita and hospitalization rates does not, in and of itself, imply that "supply creates demand". The relationship between the existing stock of nursing home beds and the factors governing supply and demand are of special interest in this study and will be discussed in detail below.

[7] We shall assume throughout that private-pay and Medicaid patients receive the same care and amenities in a given nursing home. Care and amentities may vary **across** nursing homes, however, as discussed below.

[8] Scanlon's treatment of non-profit nursing home behavior yields similar results and need not be repeated here. The treament of Medicaid rates as exogenously given to nursing home operators is tricky since states are required by law (OBRA 1980) to pay rates "which are reasonable and adequate to meet the costs which must be

facing a representative nursing home and its associated marginal revenue curve are given by D_p and MR_p. Demand at the Medicaid payment rate, P_m, is given by D_m. The profit-maximizing nursing home then set a private-pay rate of P_p and provides nursing home bed-days equal to A. It also provides B-A bed-days to Medicaid recipients at the Medicaid rate. If the market is otherwise unregulated, equilibrium must occur when entry reduces the profits of nursing homes to normal levels. As a result, anyone willing and able to pay the private rate is assured of a nursing home bed; Medicaid-eligible patients, however, may be unable to secure a bed since there is no mechanism to insure that the number of beds supplied by nursing home operators at established Medicaid payment rates is equal to the number desired by elderly Medicaid recipients. Although the model is commonly believed to imply that excess demand for beds (generated by the typical ordering: price paid by Medicaid nursing home residents < price received by nursing home owners < market-clearing price) can be expected to persist in the market, it should be clear that no such prediction arises from the model itself; the model predicts only that no market-clearing equilibrium is assured. Indeed, excess supply is as consistent with the Scanlon model as excess demand.

The Scanlon model is formulated to account for the observed traits of the market. As presented, the model has little empirical content since no alternative model accounting for the same features of the market is specified.[a] Moreover, the model does not account for "spend-down", the conversion of private-pay residents to Medicaid eligibility as assets are exhausted by payments to nursing homes.[9] Alternatives to the Scanlon model are not difficult to construct, yet little work in this vein has appeared in the literature in the ten years since its publication. A competing view of the nursing home market is formulated here; for purposes of comparison we may term it the "competitive model" since it regards all nursing homes as price takers. While the model is not developed in detail and the data available to us do not permit a test of the accuracy of the competing models, their predictions can be compared and directions for future work will be indicated.

Consider a nursing home characterized by the marginal and average cost curves displayed in Figure 3.2. Assume that the Medicaid rate is given, as before, by P_m. In a competitive market of nursing homes identical to the one displayed in the figure, Medicaid patients would not be served and private-pay patients would pay a rate of P_1 per day. Now assume, for simplicity, that all private-pay patients spend down and become Medicaid eligible after D_1 days and then remain in the nursing home for a further D_2 days as Medicaid recipients. Can this be an equilibrium? A trivial way of

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incurred by efficiently and economically operated facilities . . ."

[9] Recent work by Rice (1989) suggests that spend-down to Medicaid by nursing home residents may occur much less frequently than is generally thought. If this is the case, then Scanlon's simple distinction between Medicaid and private-pay residents may be adequate.

attaining the equilibrium occurs if all patients are discharged when they are unable to pay P_1. An alternative equilibrium is observed if a price in excess of P_1 is paid for the first D_1 days, where the discrepancy between P_1 and this higher private rate is sufficient to compensate for the shortfall of P_m below P_1 for the duration of each patient's Medicaid stay. The private-pay price that would sustain this equilibrium, P*, solves the zero-profit equation:

$$(3.1)\quad P_1(D_1+D_2) = P^*D_1+P_mD_2$$

or

$$(3.2)\quad P^* = P_1 + (P_1-P_m)\cdot\frac{D_2}{D_1}$$

Even at this very simple level of analysis, a conceptual test of the competitive model relative to the Scanlon model emerges. Consider the effect of a rise in the Medicaid payment rate, P_m, with demand and cost conditions held constant. In Scanlon's model, the private-pay price of a nursing home day also rises, though by less than the change in P_m. See Figure 3.3. The equilibrium model predicts a fall in the private-pay rate as may be seen by differentiating (3.2) with respect to P_m.[10]

$$(3.3)\quad \frac{\partial P^*}{\partial P_m} = -\frac{D_2}{D_1} \leq 0$$

While this result appears to offer a clear test of the equilibrium model versus the Scanlon model, such a test will be fairly difficult to carry out. A proper test will require that both demand and cost conditions be controlled for, so that the Medicaid rate is observed to change in isolation. Statistical control of this kind may prove quite difficult to achieve.

The simple equilibrium model is difficult to accept on two counts. First, it implies that no profit-maximizing nursing home would be willing to admit an individual who was already eligible for Medicaid, since the shortfall of P_m below minimum average cost P_1 would always produce a loss. Such admissions, however, are routinely observed. Second, relaxation of the assumption that the duration of private-pay status is fixed for all residents weakens the notion that equation (3.2) represents an equilibrium. Rearrangement of (3.2) reveals that the discrepancy between the observed

[10] At this point we ignore the effect of private-pay price on the time until spend-down to Medicaid. It can be shown. however, that allowing for a negative relationship between P_m and D_1 reinforces the result in (2).

private-pay price and the Medicaid payment rate declines as the ratio of private-pay duration to total duration rises.[11] Wealthier patients who may expect to pay private rates for an extended period would be unwilling to pay a significant premium above average cost, P_1, since their long expected duration as private-pay patients already assures that they are paying their own way. P^* cannot be lowered without producing a loss and it is unlikely that the home can succeed in charging lower rates for patients who pay out of pocket for an extended period.

Both considerations suggest that the nursing home market is likely to be stratified by quality and by the anticipated duration of new residents in private-pay status. Nursing home amenities (termed here quality, and denoted by Q) are produced at increasing average cost by the nursing home. Hence P_1, the minimum value of average cost is a positive function of amenities.[12] Since the competitive model implies that nursing homes will admit only those patients for whom they are reimbursed P_1, on average, those nursing homes that routinely admit Medicaid recipients must set quality equal to the level that will equate P_1 and the Medicaid rate P_m. In equilibrium, private-pay patients should be observed to pay a rate of P_m, since no excess is required to compensate for later reimbursement at a rate less than average cost. Loosely put, the competitive model predicts that the ratio of private to Medicaid rate will be inversely related to the proportion of residents who were Medicaid-eligible at the time of admission.

Is There an Excess Demand for Nursing Home Beds?

In an unconstrained market, excess demand exerts upward pressure on the price of a good or service which in turn stimulates production and inhibits demand so that the shortage is eliminated fairly quickly . By contrast. prices set by state Medcaid programs are usually determined by a rate-setting process or methodology designed to reflect "reasonable costs", rather than to clear the market. Absence of a market-determined price for nursing home days for Medicaid recipients, together with reports of hospital discharge delays (ANDs) for elderly patients awaiting nursing home placement, has fostered a belief that the nursing home market is characterized by persistent excess demand.

Economic theory predicts that excess demand can sometimes arise in circumstances in which prices are set by government at lower levels than would otherwise prevail. Furthermore, shortages are most likely to occur when there is little scope for modifying the nature of the good or service (its

[11] That is, $P^*-P_m = [P_1-P_m]\cdot D/D_1$, where $D=D_1+D_2$.

[12] Ullman (1985) found a strong positive association between cost per patient-day and building characteristics such as the proportion of single and double bed rooms, square feet of room space per bed, and the amount of space for diversion, social activities or dining in a nursing home.

"quality"), in response to the lower price.[b] The competitive model formulated above avoids shortages by allowing quality to fall to a point at which average cost equalled the Medicaid price. If state licensing standards or other restrictions prevent this from occurring, then shortages may well develop. It should be emphasized that under both the Scanlon model and the competitive model, the source of excess demand is the same: the nonmarket determination of the Medicaid price and the discrepancy between the price paid for nursing home care by Medicaid enrollees and the price received for care by nursing homes.

Explicit restraints on the supply of beds may exacerbate shortages in some states. Though the federal mandate for review of capital spending for nursing homes and other facilities expired in 1987, many states have continued to restrict the construction or expansion of nursing homes via Certificate-of-Need (CON) requirements or by explicit moratoriums on the construction of new nursing homes or the addition of beds to existing homes (Doty, Liu and Wiener 1985). Such barriers to the expansion of nursing home beds are often supported by state governments as a means of controlling the growth in Medicaid expenditures. They may also serve the interests of nursing home operators who are protected from competition in the more lucrative market for private-pay nursing home care.

Most of the published literature suggests that excess demand is indicated by the existence of hospital ANDs. Nevertheless, as noted in Chapter II, the evidence for severe shortages is equivocal. Few studies have attempted formal tests of the hypothesis of excess demand. We have already argued that Scanlon's test is largely invalid (See note a). Swan and Harrington (1986) attempt to estimate the magnitude of the "undersupply" of beds based on examination of least squares residuals. Their definition of undersupply is vague, however, and is not clearly linked to their empirical strategy, making their results difficult to interpret.[13] Detection of excess demand is challenging, especially in the nursing home market. A standard argument holds zero values for demand indicators in a reduced-form quantity model is an indication that demand is constrained. If state regulators use these demand indicators to set allowable limits on the number of beds, however, these indicators may be statistically related to quantity. The analyst has no way of knowing that the relationship would be much stronger in the absence of excess demand. At the same time, the existence of queues is by itself only mild evidence for excess demand, though the strength of the evidence clearly increases with the persistence of the observed queues.

Because of the multi-tiered structure of nursing home payment, a full statistical or econometric model of the determination of nursing home beds is difficult to construct. Medicaid recipients pay less for care than state Medicaid programs pay to nursing homes. Moreover, while private-pay residents

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[13] A particular problem of their analysis is a failure to distinguish the separate influences of undersupply, sampling error, and misspecification error on the least-squares residuals.

must typically pay a higher rate for care than Medicaid does, some fraction of these eventually "spend down" their assets and income, qualifying them for Medicaid. The ease with which the elderly can qualify for Medicaid varies from state to state and may be either positively or negatively correlated with the stringency of restrictions on the expansion of beds. Supply and demand functions are therefore nearly impossible to specify correctly and even reduced-form equations for total beds can be difficult to interpret. Estimates of a simple reduced-form model will be discussed below. Before turning to this model, we shall describe some of the pattern of nursing home beds in the 1980s.

Nursing Home Beds in the U.S.

Table 3.1 displays certified (by Medicare, Medicaid, or both) nursing home beds per aged Medicare beneficiary in 1981 and 1986.[14] For the U.S. as a whole, the ratio of beds to beneficiaries was remarkably stable over the period at about 53 beds per thousand beneficiaries. Contrary to popular belief the concentration of beds is somewhat greater in rural than in urban areas; furthermore, certified nursing home beds per beneficiary (or per beneficiary aged 85+) increased between 1981 and 1986 in rural areas but declined very slightly in cities. Regional disparities in the number of beds are conspicuous. By 1986, certified nursing home beds per aged beneficiary in North-Central states was more than 50 percent greater than in Western states. A comparison of beds per beneficiary aged 85+ (a crude correction for differences in the age distribution) shows the discrepancy between the two regions to be about 41 percent.

Table 3.2 disaggregates the means reported in the previous table and displays the distribution of hospital-based beds. The decline in nursing home beds in the West can be clearly seen here. The region experienced a greater relative increase in aged beneficiaries than any other part of the country between 1981 and 1986; certified nursing home beds, however, increased by less than four percent. less than half the rate of increase of any other region. The dramatic rise in hospital-based nursing home beds is also evident in the table. The data do not allow swing beds to be distinguished from beds in distinct nursing home units of hospitals, but the disproportionate rise in beds in rural areas and in the largely rural central and southern states suggests that much of the increase is due to addition of swing beds to rural hospitals.

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[14] Nursing home beds are typically measured relative to the over-65 population. Since I considered the counts of aged Medicare beneficiaries at the county level to be more accurate than alternative estimates of the over-65 population, and because the two are quite similar in any event, I have chosen to use aged beneficiaries as the denominator in this study.

Tables 3.1 and 3.2 do not distinguish between beds that are certified for skilled or intermediate care because available data do not identify the type of certification until 1985. Certified beds per aged beneficiary by type of certification for 1986 are displayed in Table 3.3. The western U.S., with the lowest ratio of certified beds per beneficiary nevertheless has the highest ratio of SNF beds per beneficiary: 37 per thousand beneficiaries - slightly more than in the North-Central states (which have the highest ratio of total certified beds to beneficiaries) and nearly double the concentration of SNF beds in the South at 20 per thousand beneficiaries.[15] The table also shows that the dearth of ICF beds in the West is understated by Table 3.1. The total number of ICF beds per thousand beneficiaries in the West is just 21, compared to nearly 61 per thousand in North-Central states although the portion of aged beneficiaries over the age of 85 is nearly identical in the two regions at roughly ten percent.

A Simple Reduced-Form Model of Nursing Home Beds

As noted above, a structural model of the market for nursing home beds would be difficult to specify and virtually impossible to estimate without data that describe the numbers of Medicaid and private-pay residents of nursing homes, the rate at which private patients become Medicaid-eligible, and some means of identifying areas in which the expansion of nursing home beds has been regulated or constrained. As an alternative to such an ambitious undertaking, I present here an elementary reduced-form model of the market. The nature of the equilibrium in this model is left unspecified by intention. A standard reduced-form model represents supply and demand equations from which price has been solved out, so that the equilibrium quantity is expressed as a function of variables believed to affect either supply or demand. Since price is not assumed to clear the market for nursing home beds. the actual manner in which equilibrium is achieved is not apparent though the model presented just above suggests that variations in nursing home amenities coupled with similar variations in the mean time until Medicaid eligibility may act to clear the market.

The most significant difficulty encountered by the analyst in estimating the determinants of nursing home beds lies in capturing legislative and regulatory barriers to expansion of the number of beds. The equations estimated here contain terms representing the mean per diem Medicaid payment to ICFs and an indicator variable which equals one for states that have facility-specific prospective

[15] Total SNF beds per beneficiary is computed as the sum of SNF and SNF/ICF beds per beneficiary in Table 3.3. Total ICF beds per beneficiary are computed similarly.

payment systems.[16] Other attempts to limit the growth of beds, such as CON or moratoria on additional beds are not included here and constitute a significant left-out variable in the analysis.

Two forms of the model are estimated: 1) a cross-sectional equation with 1986 county-level ICF beds as the dependent variable and county characteristics as covariates, and 2) a county-level equation with the 1981 to 1986 change in certified nursing home beds as the dependent variable and 1981 to 1986 changes in county characteristics as covariates. Both equations are estimated separately for urban and rural counties. Certified beds are assumed to be functions of the following county-level variables.

AGED BENEFICIARIES	Number of aged Medicare beneficiaries in county
BENEFICIARIES AGED 80-84	Number of beneficiaries aged 80-84
BENEFICIARIES AGED 85+	Number of beneficiaries aged 85 and over
COUNTY POPULATION	
COUNTY POPULATION SQUARED	
PER CAPITA INCOME	
HOSPITAL BEDS PER 1000 POP	
MEDICAID ICF RATE	Mean ICF per diem, deflated to 1981 dollars
PROSPECTIVE FS	=1 if state has facility-specific prospective system
MEDICARE SHARE	Ratio of Medicare aged beneficiaries to county population
MD PER 1000 POP	Ratio of office-based physicians to county population
MEDHMO	Number of Medicare HMO enrollees in county
CB2176	Dollar value (in 1986) of community-based 2176 waiver expenditures for aged and disabled per beneficiary in <u>state</u> (not county)

The signs of most of these covariates cannot be predicted. The variables AGED BENEFICIARIES, BENEFICIARIES AGED 80-84, and BENEFICIARIES AGED 85+ are demand shifters and are expected to be positively related to the number of beds. Most other variables might logically appear as arguments to both the supply and demand functions and so their coefficients have no clear predicted value.

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[16] A reduced-form quantity equation would not ordinarily include a price term since price is assumed to be solved out of the demand and supply relations. The Medicaid payment rate however is received by providers but is not, in most cases, paid by residents. Since this price is not assumed to adjust to clear the market, it remains in the reduced form and is expected to have a non-negative sign.

The cross-sectional and differenced models are subject to alternative biases which must be kept in mind when examining the estimates. In the cross-sectional model, effects of included variables on nursing home beds are inferred from geographic differences among counties. The danger here is that other influences on the demand or supply of nursing home beds that are left out of the equation but which are correlated with included variables may lead to serious bias in the estimated effects of the included covariates. Suppose, for example, that areas with a high proportion of very old (aged 85+) beneficiaries are especially likely to be composed of extended families that make particular efforts to care for aging parents in the homes of relatives. This pattern of care is impounded in the disturbance term of the regression equation. As a result the cross-section estimate of the effect of the proportion of beneficiaries who are aged 85 and over on the number of nursing home beds would be a poor estimate of the effect of a secular increase in the proportion of beneficiaries over age 85 on the number of nursing home beds in any area. This sort of bias due to left-out variables is typically attenuated in difference models because persistent omitted variables are differenced out. Suppose that the reduced-form beds equation is represented in standard form by equation (3.4) below.

$$(3.4)\quad Q_{it} = X_{it}\beta + u_{it}$$

Omitted variables (assumed for simplicity to be completely unchanging over time) that are left out of the model may be represented as a component of the disturbance term, u.

$$(3.5)\quad u_{it} = \phi_i + \varepsilon_{it}$$

Note that when (3.4) is differenced, persistent omitted variables represented by ϕ drop out of the resulting model, reducing or eliminating bias of the type just described.

$$(3.6)\quad \Delta Q_{it} = \Delta X_{it}\beta + \Delta u_{it} = \Delta X_{it}\beta + \Delta\varepsilon_{it}$$

While the differenced model represented by (3.6) is often preferred to the cross-section model because of the reduced potential for omitted-variable bias, it is itself subject to alternative though perhaps less serious sources of bias - particularly those due to measurement error. When covariates are measured inaccurately, least-squares coefficient estimates can be shown to be biased toward zero in most cases. When a model is differenced, as is equation (3.6), the effect of the measurement error is magnified. For this reason, the estimated coefficient of ICFRATE, for example, which is a mean over all certified ICFs in a state and need not represent the payment rate to any particular

nursing home, may be biased toward zero in both models; the effect of measurement error alone is likely to be particularly pronounced in the difference formulation. In general, however, I will regard the results of the difference model as a more accurate indicator of the effect of changes in given variables.

For the difference models (estimated on 1981 to 1986 changes), the covariates listed above were replaced by their 1981 to 1986 differences, denoted, for example, by ΔMDPOP. Due to collinearity problems, ΔPROSPECTIVE FS and ΔMEDICARE SHARE were omitted from this second specification. Because accurate counts of the small number of Medicare HMO enrollees in 1981 are not available and because there was no 2176 waiver program in 1981, the variables MEDMHO and CB2176 are represented in this regression by their 1986 values. Least-squares results are given in Tables 3.4 and 3.5.

In rural areas, increased numbers of beneficiaries appears to be associated with no change or with a decrease in the number of nursing home beds. Since the number of beneficiaries aged 80 and over is held constant here, it is possible that increases in beneficiaries under the age of 80 might have little or no effect on the number of beds, though a negative effect is difficult to explain. The cross-section results appear to understate the effect of increases in the number of beneficiaries in the oldest age category: the difference model shows that each additional beneficiary aged 85 and over increases the number of beds by 0.3 to 0.4. The difference formulation suggests that beds increased most rapidly in those states in which the mean Medicaid ICF payment increased the most over the period. This result is predicted by theory since the ICF payment rate represents a pure supply effect; the level regressions nevertheless indicate a negative effect which might perhaps be explained by the nature of Medicaid rate setting at the state level.[17] Of some interest is the pattern of coefficients for 2176 waiver expenditures per beneficiary. The level regressions in Table 3.4 indicate that counties in states with high per capita federal waiver expenditures tended to have higher numbers of ICF beds. However, Table 3.4 indicates that each additional dollar of per capita federal waiver expenditure is estimated to have reduced the rate of growth of certified nursing home beds by 2.9 beds in urban areas and by about one half bed in rural areas. The negative effect may reflect both a reduction in the demand for beds in areas in which higher levels of community-based care and also a conscious policy of some states to encourage 2176 waiver applications as a governmental substitute for the certification of new beds.

[17] Medicaid rate setting is a contentious political issue in many states. Providers have often argued that payment rates are determined after the overall Medicaid budget is set. If the variance in the (real) size of budgets is smaller than the variance in the number of beds across states, then a negative correlation may arise between the number of beds (for example) and the real payment rate.

None of the results presented here support or contradict the hypothesis of excess demand for nursing home beds. Clear tests of the hypothesis probably require person-level data not available for this analysis.

Price Discrimination in the Nursing Home: Scanlon Model

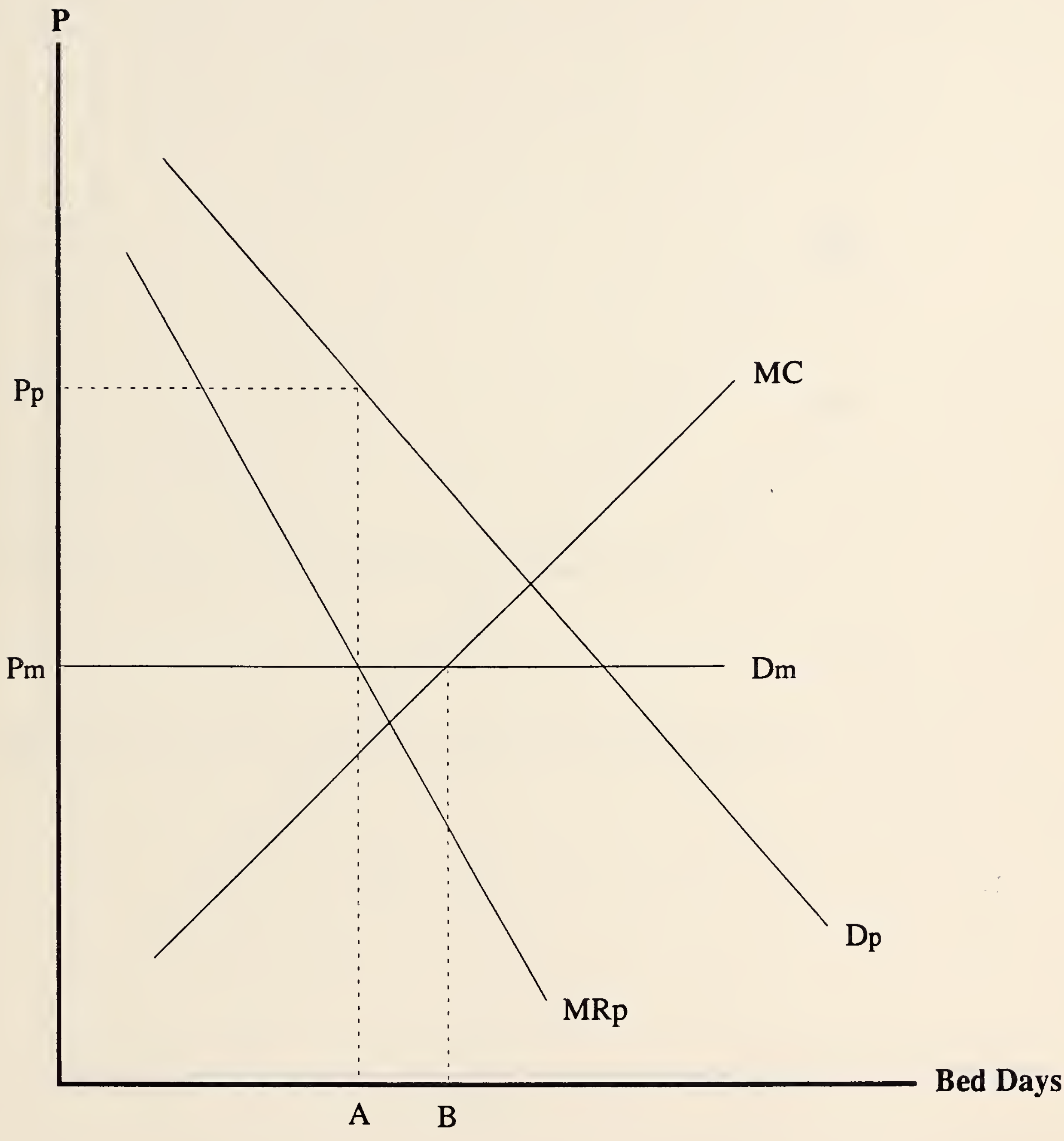

Figure 3.1

Equilibrium for a Competitive Nursing Home

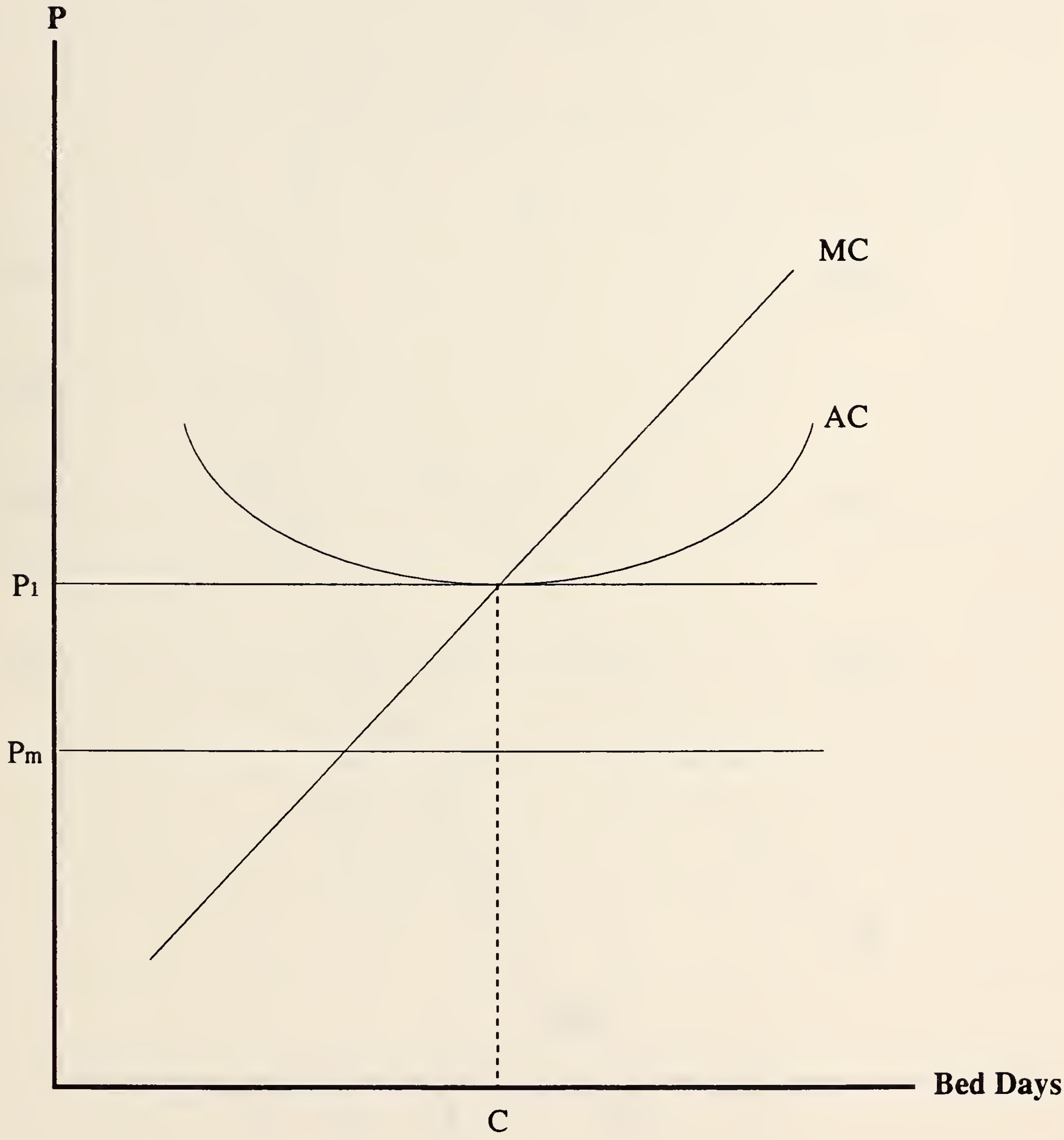

Figure 3.2

Changing the Medicaid Payment Rate Under the Scanlon Model

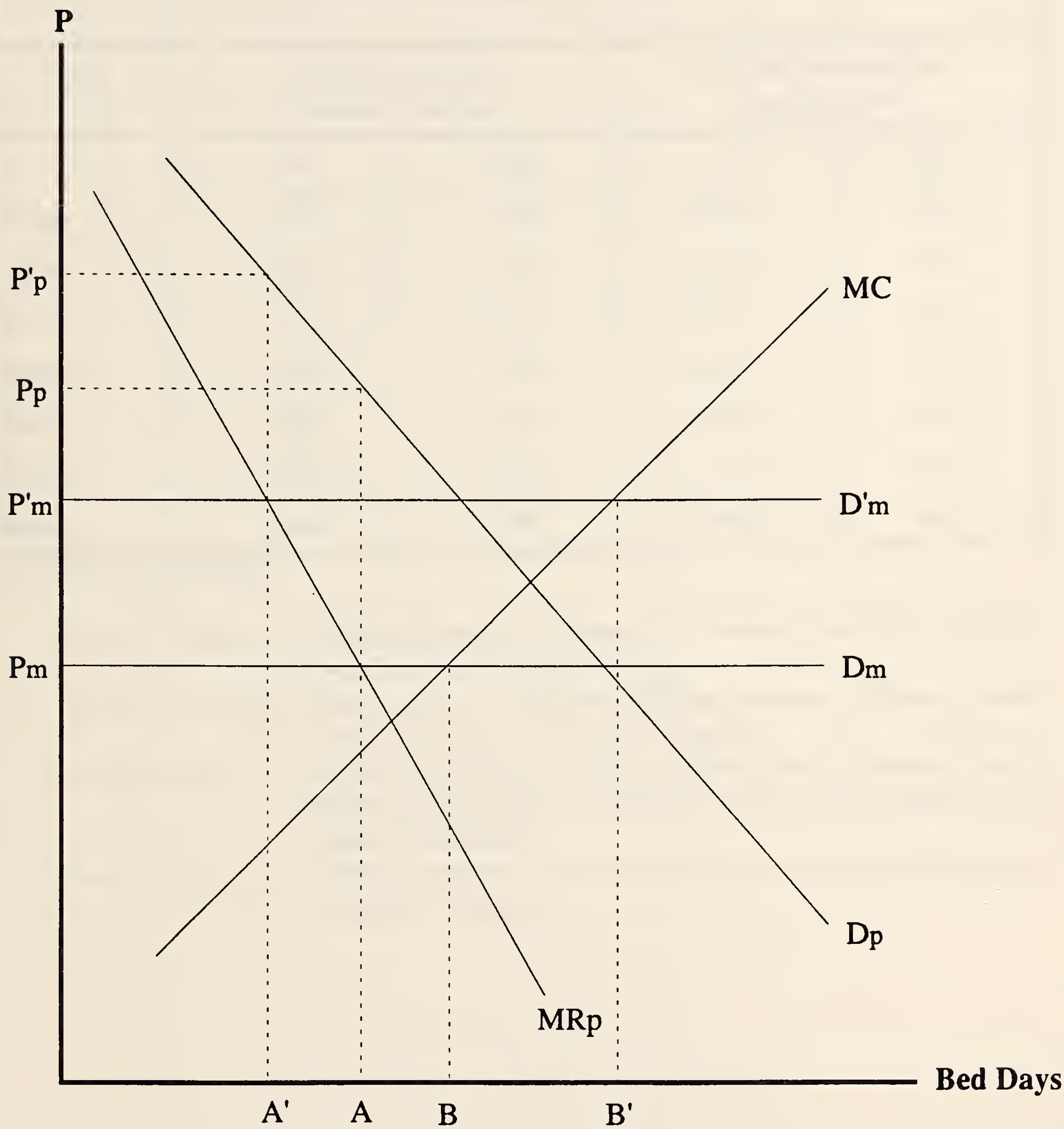

Figure 3.3

Table 3.1

Medicare/Medicaid Certified Nursing Home Beds
Per Medicare Beneficiary: 1981 and 1986

Area	Mean Beds Per Aged Medicare Beneficiary		Mean Beds Per Beneficiary Aged 85 and Over	
	1981	1986	1981	1986
Overall	0.0527	.0528	0.5160	.5140
Urban	0.0495	.0492	0.4853	.4795
Rural	0.0603	.0617	0.5877	.5955
Region 1	0.0471	.0501	0.4451	.4708
Region 2	0.0663	.0673	0.6123	.6160
Region 3	0.0475	.0476	0.5022	.4952
Region 4	0.0488	.0443	0.4802	.4377

Note: Arizona not included

Region 1: Northeast	Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont
Region 2: North Central	Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin
Region 3: South	Alabama, Arkansas, Delaware, D.C., Florida, Georgia, Kentucky, Louisiana, Maryland, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia
Region 4: West	California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming

Table 3.2

Levels and Rates of Change for Selected Variables: 1981 and 1986

Area	Certified NH Beds			Hospital-Based NH Beds			Aged Beneficiaries			Beneficiaries Aged 85+		
	1981	1986	% change	1981	1986	% change	1981	1986	% change	1981	1986	% change
Overall	1,299,073	1,434,774	+ 9.9%	61,326	72,782	+17.1%	24,652,593	27,150,067	+ 9.6%	2,517,446	2,791,659	+10.3%
Urban	855,243	941,181	+ 9.6%	37,583	37,698	+ 0.3%	17,293,181	19,144,186	+10.2%	1,762,261	1,962,836	+10.8%
Rural	443,830	493,593	+10.6%	23,743	35,084	+39.0%	7,359,412	8,005,881	+ 8.4%	755,185	828,823	+ 9.3%
Region 1	282,108	321,171	+13.0%	20,345	18,284	-10.7%	5,985,585	6,410,238	+ 6.9%	633,865	682,249	+ 7.4%
Region 2	442,891	482,105	+ 8.5%	17,743	24,611	+32.7%	6,677,560	7,161,661	+ 7.0%	723,344	782,625	+ 7.9%
Region 3	386,283	436,948	+12.3%	12,213	17,552	+36.3%	8,140,164	9,181,562	+12.0%	769,196	882,310	+13.7%
Region 4	187,791	194,550	+ 3.5%	11,025	12,335	+11.2%	3,849,284	4,389,606	+13.1%	391,040	444,475	+12.8%

Table 3.3
Nursing Home Beds Per Beneficiary by Type of Certification: 1986

Area	SNF Certified Beds	ICF Certified Beds	SNF/ICF Certified Beds
Overall	0.0117	0.0234	0.0178
Urban	0.0130	0.0191	0.0171
Rural	0.0087	0.0336	0.0194
Region 1	0.0167	0.0195	0.0138
Region 2	0.0065	0.0310	0.0297
Region 3	0.0067	0.0276	0.0133
Region 4	0.0234	0.0077	0.0132

Table 3.4

OLS Estimates of Reduced-Form Equation for Certified ICF Beds

Variable	Urban	Rural
Intercept	342.13 (314.56)	-64.49** (23.56)
AGED BENEFICIARIES	0.08** (0.01)	-0.09** (0.007)
BENEFICIARIES AGED 80-84	-0.37** (0.12)	0.62** (0.08)
BENEFICIARIES AGED 85+	0.16* (0.085)	0.21** (0.05)
COUNTY POPULATION	-0.0007 (0.0005)	0.005** (0.0003)
COUNTY POPULATION^2	-9.3×10^{-11}** (3.3×10^{-11})	-1.8×10^{-9}** (1.8×10^{-10})
PER CAPITA INCOME	34.83 (22.38)	7.37** (1.67)
HOSPITAL BEDS PER 1000 POP	69.94** (21.87)	1.28* (0.74)
MEDICAID ICF RATE	-9.32 (5.88)	-1.64** (0.49)
PROSPECTIVE FS	-228.37** (81.98)	-42.36** (6.19)
MEDICARE SHARE	-2412.82 (1549.36)	681.67** (88.17)
MD PER 1000 POP	252.05** (97.42)	-5.78 (7.64)
MEDHMO	-0.09** (0.009)	-0.13** (0.006)
CB2176	7.19* (3.81)	0.31 (0.24)
R^2	0.67	0.65
N	671	2301

Note: Standard errors in parentheses.
* Significant at p=0.10
** Significant at p=0.05

Table 3.5

OLS Estimates of Reduced-Form Equation for Change in Certified Beds: 1981-86

Variable	Urban	Rural
Intercept	57.75**	4.82*
	(26.61)	(2.73)
ΔAGED BENEFICIARIES	0.02*	-0.006
	(0.009)	(0.009)
ΔBENEFICIARIES AGED 80-84	-0.08	0.15**
	(0.06)	(0.05)
ΔBENEFICIARIES AGED 85+	0.31**	0.38**
	(0.06)	(0.07)
ΔCOUNTY POPULATION	-0.003**	-0.002**
	(0.0005)	(0.00007)
ΔCOUNTY POPULATION^2	-5.1×10^{-11}	-2.7×10^{-10}
	(4.4×10^{-11})	(3.4×10^{-10})
ΔPER CAPITA INCOME	-3.12	1.09
	(7.10)	(0.90)
ΔHOSPITAL BEDS PER 1000 POP	11.38	0.25
	(17.37)	(0.75)
ΔMEDICAID ICF RATE	6.92**	1.12**
	(1.66)	(0.25)
MEDHMO	-0.002	-0.001
	(0.002)	(0.002)
CB2176	-2.89**	-0.52**
	(0.87)	(0.10)
R^2	0.26	0.15
N	670	2296

Note: Standard errors appear in parentheses
* Significant at p=0.10
** Significant at p=0.05

NOTES TO CHAPTER III

a. Scanlon asserts that a clear test of the hypothesis of excess demand is provided by the regression of both total utilization (nursing home residents per population aged 65 and over) and private utilization (private-pay residents per 65+ population) on unfilled nursing home beds per population aged 65 and over. If there is excess demand, he argues, the total utilization regression should yield a positive and significant coefficient, indicating the effect of increased supply on utilization. Private-pay patients, however, are assured of a bed so supply should have little observed effect on their utilization. Hence the coefficient of unfilled beds is predicted to be small.

Because the coefficient of unfilled beds is positive and significant in the total utilization equation and is small and statistically insignificant in the private utilization equation, Scanlon concludes that the excess demand hypothesis is supported, a conclusion that is unwarranted by the results. Because every nursing home resident must occupy a bed, Scanlon's regressions amount to nothing more than the regression of filled nursing home beds on unfilled beds; the coefficient of unfilled beds represents the observed rate of change of filled beds with respect to unfilled beds (conditional on other included variables). In the simple regression of utilization on unfilled beds per elderly person (reported in Scanlon's Table 2), the least-squares coefficient is exactly equal to the sample ratio of filled beds to unfilled beds. The coefficient of unfilled beds is thus smaller in the private utilization regression for purely mathematical reasons, i.e. because the number of beds occupied by private-pay patients is less than the total number of occupied beds. Scanlon's empirical work thus does little to establish the existence of excess nursing home demand.

b. Economic theory does not yet contain a canonical treatment of the joint determination of the equilibrium output and quality of a good. Rosen (1974) remains the most frequently-cited approach to the problem. As a general illustration of the tradeoff between adjustments in quantity (shortages) and in quality, consider the responses to price controls in the mid-1970s. These price controls. together with the rise in world oil prices, led to shortages and queues for gasoline in the United States. At the same time, beef, though widely available in stores, was often sold with more fat and bone than was previously the case. The reason is fairly clear. While the attributes (fat, bone) of many cuts of meat can be adjusted by produceres without losing its identity, there is little scope for changing the attributes of gasoline without markedly lowering its usefulness as a fuel.

Chapter 4

Data

The unit of observation for all analyses reported here is the county-year. All data used in the analyses are therefore measured at the county level or were aggregated to the county level in the process of constructing the database. Hospital admissions, total inpatient days, and hospital readmissions among all aged beneficiaries and among those aged 85 and over were drawn from MEDPAR claims files for the years 1981 through 1986.[18] (Because MEDPAR data represent the utilization of a randomly-selected 20 percent sample of beneficiaries, all utilization totals were multiplied by five after aggregation.) Counts of beneficiaries enrolled in Part A of Medicare, by county of residence, were secured from the Master Enrollment Files for the same years. Certified nursing home beds were aggregated to the county level from the Medicare/Medicaid Automated Certification System (MMACS).[19] Other county-level descriptive data, such as population, number of patient-care physicians and counts of hospital beds, were drawn from the Area Resource File (ARF).

For years prior to 1985, it is not possible to distinguish clearly between Medicare-certified, Medicaid-certified and jointly-certified nursing home beds. In similar fashion, SNF beds cannot always be distinguished from jointly-certified SNF/ICF beds.

The resulting file contains data for each of the 3070 counties in the 48 contiguous states for 1981 and 1983 through 1986.[20] From data contained in the file, analysis variables such as the hospital admission rate, average length of stay, and probability of readmission were computed.

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[18] The MEDPAR claims files do not contain records of readmissions since these are not generally relevant for payment. A readmission is defined here as an inpatient claim with an admission date occurring within 30 days of the discharge date shown on a prior inpatient claim for the same patient. Readmissions are counted and aggregated to the county level just as admissions and inpatient days.

[19] I am especially grateful to Ms. Margaret Sulveda of the Urban Institute for providing me with the 1983 MMACS data.

[20] MMACS data are not available for 1982.

Chapter 5

Nursing Home Beds and Medicare Hospital Utilization

Introduction

The empirical strategy employed here to investigate the substitutability of nursing home care for alternative dimensions of hospital care uses the correlation between nursing home beds and hospital admissions or hospital days across geographical areas to gauge the expected effect of an increase in nursing home beds on the utilization of hospital care. This approach, which has been used by Holahan et. al. (1989) and Kenny and Holahan (1990) in similar investigations, requires the imposition of several assumptions that have not been fully discussed in the literature. These assumptions are necessary to allow valid inferences about substitution to be drawn from estimates based on geographic cross-section data. The assumptions, in increasing order of importance are: 1) that the number of nursing home beds per Medicare beneficiary in a locality serves as a reasonable proxy for the access of those beneficiaries to nursing home care, 2) that the geographic areas selected as units of analysis represent fairly accurate market areas from the point of view of most elderly residents of those areas, and 3) that the mechanisms that determine the number of nursing home beds in an area are independent of unobserved determinants of hospital utilization. Each of these assumptions will be discussed in turn.

The Relation Between Beds and Access

It is generally necessary in studies of this type to assume that residents of areas in which the ratio of nursing home beds to elderly persons is high have greater access to care, that is, have an easier time securing care when it is desired, than do residents of areas in which the ratio is low. State-to-state variation in eligibility standards for Medicaid, in regulation of Medicaid nursing home payment, in the severity of screening for appropriateness of nursing home care, as well as general variation in the prevalence of other insurance coverage for long-term care (such as VA or CHAMPUS) all may tend to undermine this assumption. For example, states with a large number of nursing home beds relative to their elderly population may attempt to control Medicaid outlays by restricting access of Medicaid recipients to nursing home care or by imposing stringent tests of financial need on elderly Medicaid applicants than states with few beds relative to their elderly population. If this sort of governmental behavior generally occurred at the state level, then the observed relationship between nursing home beds and hospital utilization would understate, in absolute value, the actual

extent of substitutability of hospital and nursing home care.[21] Because the researcher's ability to control for all such confounding influences is limited in nearly all cases, the validity of using the number of nursing home beds per elderly person in an area as a measure of access to nursing home care hinges on the absence of a systematic relationship between the number of beds in an area and all unmeasured forces tending to enhance or diminish the availability of institutional nursing home services to the elderly.[22]

Defining Market Areas for Hospital and Nursing Home Care

Any individual (or caretaker) who is searching for nursing home care arrives somehow at an appropriate area within which a potential nursing home placement would be deemed reasonable. This area will typically be defined implicitly rather than explicitly in such a way as to accommodate the desires of other family members as well as of the individual seeking placement. For this reason, the size and location of the relevant search area will vary from person to person within a geographical area and will vary, on average, across areas as well. A reasonable conjecture, supported by anecdotal evidence, is that individuals seeking a nursing home bed search over a wider area and are willing to accept placement farther from their own homes and relatives in communities in which vacancy rates are low and available beds are scarce than they are in communities where beds are more readily available.

The data used for this analysis and others similar to it consist of measures of nursing home beds and hospital utilization each aggregated to the same geographical level (e.g. ZIP code, county, state). This aggregation may (though by no means must) lead to bias in estimating the effect of nursing home beds on utilization. Suppose that data have been aggregated to the county level and that in some counties beneficiaries scan over an area of five counties for nursing home beds and in other counties. beneficiaries scan over an area smaller than the particular county itself. Then the cross-section relationship between county-level counts of nursing home beds and Medicare hospital admis-

[21] One route of action of this type has been raised by Betty Cornelius of the Health Care Financing Administration. She points out that nursing homes in some states with requirements for very dense staffing ratios may elect not to fill all of their beds but rather to keep some beds vacant if doing so will allow them to meet the required ratios. Although these beds may continue to be licensed and certified for Medicaid or Medicare use, their inclusion in a count of the "available supply" of beds clearly results in an overestimate of the number of beds available in the locality. If available nursing home beds are measured with error, then least squares estimates of the effect of beds on utilization will tend to be biased toward zero.

[22] The general problem here is known as simultaneity bias; it will be discussed in greater detail later in the chapter.

sions will, in general, understate the strength of the true relationship.[23] Little can be done at this point to address the problem; for the remainder of this paper, we shall assume that *on average* Medicare beneficiaries search for nursing home care within the same area that hospital utilization is measured.

What Determines the Number of Nursing Home Beds?

In using a relationship between observed nursing home beds and hospital admissions or days estimated on cross-section data as a means of assessing the effect of nursing home beds on hospital use, we must, of course, assume that the number of nursing home beds is not itself affected by hospital use. In fact, we must assume something stronger than this - that any unobserved influences on the number of nursing home beds in a particular area are independent of influences affecting hospital utilization in the area. If some areas have developed a style of medical practice that emphasizes institutional care, then these areas may exhibit relatively high admission rates and, over time, may also have tended to experience greater than average construction of nursing home facilities and beds. Other areas that may have developed a quite different style of medical practice that discourages institutional forms of care, may show low admission rates and few nursing home beds. The resulting positive observed correlation between nursing home beds per beneficiary and hospital admission rates would then incorrectly suggest that added nursing home beds encourage hospital admissions though in point of fact, both are positively related to the unobserved variable "practice patterns" and no causal relation between nursing home beds and hospital admissions exists. While no fully satisfactory remedy for this potential problem exists, certain methods are available for checking the appropriateness of the assumption that nursing home beds are determined independently of hospital admissions. These will be discussed below.

Approaches to Estimation

The analysis presented here is directed at three related measures of hospital utilization, each defined within specified geographical areas: the admission rate, average length of stay, and the rate of rehospitalization within 30 days of discharge. In developing a statistical model for these measures at the area level it is important to recognize that the most important determinants of hospital utilization are defined at the level of the individual; hence variables such as health status, difficult to measure in any case, are greatly attenuated when utilization is aggregated across many persons. The model expresses the logarithm of each of the three utilization measures in turn as appropriately weighted linear functions of characteristics of the area. These characteristics are presented in Table 5.1 below.

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[23] This is a standard result in the treatment of errors-in-variables and will be discussed further when the statistical model is presented. A more serious source of bias arises if the area of search is systematically related (perhaps inversely) to the number of nursing home beds per elderly person.

The influence of each characteristic is inferred from the least squares estimate of its regression coefficient. In particular, the effect of variations in the number of nursing home beds on a generic utilization measure y is estimated by the term β_k in the expression

$$(5.1)\quad \log(y_i) = \beta_0 + \beta_1 \log(x_{1i}) + \ldots + \beta_k \log(\mathit{NURSING\ HOME\ BEDS}_i) + \varepsilon_i$$

where the x's represent values of the covariates listed in Table 5.1. The development of equation (5.1) is treated below.

Issues in Estimation

Before estimating a regression equation such as (5.1), a treatment of its derivation from a disaggregated model of behavior will be useful. This discussion will serve to highlight the role of the assumptions presented earlier in the chapter and will demonstrate how the weighting scheme arises from the aggregation process.

For a given Medicare beneficiary, the log odds of a hospital admission in a particular year will be assumed here to be governed by a linear (in parameters) function of beneficiary and area characteristics. The probability of hospital admission for beneficiary i may be expressed as the probability that an indicator (0-1) variable A_i, equals one:

$$(5.2)\quad \log[\frac{p_i}{(1-p_i)}] = X_i\beta;\quad p_i = Pr(A_i=1),\quad i = 1, \ldots, n$$

where X_i represents individual and area-level determinants of the probability of hospital admission and n is the number of beneficiaries residing in the area. The actual probability of admission is then given by the well-known logistic relationship so that the log odds of the observed admission rate in an area is computed by properly aggregating (5.2) over all beneficiaries in the area and may be written as

$$(5.3)\quad \log[\frac{\hat{p}}{(1-\hat{p})}] = X\beta + \varepsilon;\quad \hat{p} = \frac{1}{n}\Sigma A_i;\quad \varepsilon \approx \frac{\hat{p}-p}{p(1-p)}$$

a formulation known as the minimum logit chi-square model, first proposed by Berkson (1953). Aggregation across beneficiaries reduces many of the difficulties associated with estimating a model of discrete events (such as hospital admission) using individual data.[24] Berkson proved that weighted least squares applied to (5.3) using the square root of $[np(1-p)]^{-1}$ as weights produces consistent

[24] The derivation here follows Maddala (1983). The actual form of the model estimated here is a variant proposed by Cox (1970) which is less sensitive to remainder terms arising from the Taylor series approximation used to derive (4.3) from (4.2). See Amimeya (1985) and Cox on this point.

asymptotically normal estimates of β. In the regressions to be reported later, probability of hospital admission and of rehospitalization within 30 days of discharge are both estimated using a formulation such as (5.3). Hospital length of stay is estimated using an equation similar to (5.1).

Three issues remain to be discussed: 1) the appropriateness of treating nursing home beds as an exogenous determinant of utilization, 2) the effect of using counts of beds within counties as the appropriate measure of bed availability, and 3) the proper treatment of SNF and ICF-certified beds in the specification of regression equations for hospital utilization.

Exogenous versus Endogenous Nursing Home Beds

The number of nursing home beds relative to the elderly population in an area is determined by an array of influences including state and local regulatory practices, Medicaid payment rates, and established patterns of medical practice. Many if not most such influences are of long duration and do not fluctuate significantly from year to year. If some of these same influences also affect the rate of hospital utilization, then estimation of the effect of nursing home beds supply on hospital utilization via least squares is unlikely to produce unbiased estimates of the results we seek. In order to see this clearly, consider a regression equation for length of stay for county i in year t.

Table 5.1
Variable Definitions: 1985

Variable	Mean	Description
POP	77,228	County population
AGED BENEFIC	8,793	Number of aged (65+) Medicare beneficiaries in county
BENEF 80-84	1,080	Number of Medicare beneficiaries aged 80-84 in county
BENEF 85+	899	Number of Medicare beneficiaries aged 85 and over in county
URBAN	0.23	= 1 if county is located in MSA = 0 otherwise
NORTH CENTRAL	0.34	= 1 if county is located in OH, IN, IL, MI, WI, IA, MN, MO, ND, SD, NE, KS = 0 otherwise
SOUTH	0.45	= 1 if county is located in DE, MD, DC, VA, WV, NC, SC, GA, FL, KY, TN, AL, MS, AR, LA, OK, TX = 0 otherwise
WEST	0.13	= 1 if county is located in MT, ID, WY, CO, NM, AZ, UT, NV, WA, OR, CA = 0 otherwise
HOSPITAL BEDS	350	Number of short-term general hospital beds in county
CERT NH BEDS	456	Number of certified (Medicare or Medicaid) nursing home beds in county
CERT SNF BEDS	254	Number of certified SNF beds in county
CERT SNF BEDS*	102	Number of beds certified for SNF but not ICF care in county

$$(5.4)\quad \log(LOS_{it}) = X_{it}\beta + \alpha \log(NHBEDS_{it}) + \phi_i + \varepsilon_{it}$$

where ϕ_i represents unobserved determinants of length of stay that are unchanging over time in county i.[25] Many of these same unobserved influences captured by ϕ_i may impinge on the stock of available nursing home beds since these are likely to have been affected by longstanding patterns of care in a community. The current stock of nursing home beds then might be specified as

$$(5.5)\quad \log(NHBEDS_{it}) = \sum_j (Z_{it-j}\gamma_{t-j}) + \delta\phi_i + u_{it}$$

where the Z_{it} represent past and current influences on increments to the stock of beds. For simplicity, assume that NH BEDS and X are orthogonal. Then the probability limit of the least squares estimate of α in (5.4) can be shown to be

$$(5.6)\quad plim(\hat{\alpha}) = \alpha + \frac{\delta\sigma_{\phi}^2}{\sigma_{NHBEDS}^2}$$

Since δ is unsigned, the direction of the bias cannot be ascertained. To the extent that variation in factors common to the determination of length of stay and nursing home bed stocks is small (σ_{ϕ} is small relative to σ_{NHB}), the inconsistency of the OLS estimator of α is not severe. For this reason, OLS estimates of utilization equations like (5.4) will be presented. The availability of data from more than a single year, however, enables us to remove the inconsistency brought about by the presence of ϕ (though it has the potential for introducing other problems as we shall see). Since ϕ_i is constant over time, differencing (5.4) across nearby years removes the source of the inconsistency. Least squares, applied to (5.7) below, results in fully consistent estimates of α and β.[26]

$$(5.7)\quad \log\left(\frac{LOS_{it}}{LOS_{it-1}}\right) = (X_{it}-X_{it-1})\beta + \alpha\log\left(\frac{NHBEDS_{it}}{NHBEDS_{it-1}}\right) + (\varepsilon_{it}-\varepsilon_{it-1})$$

Differencing across years will change the weighting scheme for minimum logit chi-square models since the variance of the disturbance term is higher in differenced models.

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[25] The assumption that ϕ_i does not change is clearly extreme. Other specifications that allow ϕ to behave as a moving average over time would be more realistic but would also complicate the exposition considerably. The treatment of ϕ as fixed introduces all the essential ideas in a framework that is fairly easy to present.

[26] An analogous procedure can be used when more than two years of data are available. Such estimators are generically termed 'fixed effects' or 'covariance' models.

Measuring Bed Supply

As noted earlier in the chapter, ideal estimation of the effect of nursing home bed supply on hospital utilization requires that the dependent variable be aggregated to the same geographical level as that over which elderly individuals or their caretakers typically search for nursing home beds. Since this area has not been ascertained in any previous research, the work reported here must rely on maintained assumptions about the proper level of aggregation.

In this section we briefly discuss the effects of improper aggregation and show that the effects of over-aggregation tend to be less severe than those of insufficient aggregation. To see this, consider two nested areas which we shall, for simplicity, refer to as counties and states. Nursing home beds per elderly person in county i of state s, NHB_{is}, may be written as the state average $NHB_{s.}$ plus the county's deviation from the average, θ_{is}.

$$(5.8)\quad NHB_{si} = NHB_{s\cdot} + \theta_{is}$$

Assume now that the individuals seeking nursing home placement search at the level of the state; that is, the appropriate measure of nursing home beds per capita is $NHB_{s.}$. Then if we regress county hospital utilization, measured by y_{it} on nursing home beds per elderly measured at the county level, then the least squares coefficient of nursing home beds per elderly can be shown to be biased toward zero. The probability limit of the OLS coefficient, say $\hat{\alpha}$ is given by

$$(5.9)\quad plim\hat{\alpha} = \alpha\left(\frac{\sigma^2_{x_s}}{\sigma^2_{x_s} + \sigma^2_{\theta}}\right)$$

The smaller is county-to-county variation relative to state-to-state variation, the smaller is the underestimation of α. However, even if the county-level variance of nursing home beds per elderly is half of the state-to-state variance (a fairly conservative assumption) then the OLS estimate will still be downward biased by one third.

Now assume the converse, that individuals search only over their county of residence, but that we estimate the effect of nursing home beds per elderly estimated at the state level on hospital utilization measured at the state level. The coefficient of nursing home beds per elderly can then be shown to be unbiased and consistent. The only result of failure to estimate the relationship at the (appropriate) county level is a loss of efficiency -- the OLS estimator does not have minimum variance. While tests (e.g. Hausman 1977) are available to attempt to discriminate between the two, the results to be reported here will rely on estimation at the two most convenient levels of aggregation -- the county and the state.

Specification of the Effect of Nursing Home Beds

To this point, we have treated nursing home care as a homogeneous commodity and have not discussed the ways in which variations in the level of care associated with different types of nursing home beds may impinge on the use of hospital care in communities. Because levels of nursing home care differ, the relationship of hospital utilization to nursing home beds per capita may be expected to vary with the composition of beds. Beds certified for skilled care (SNF beds) are likely to substitute more effectively for hospital beds than are beds certified for intermediate care (ICF beds). The effect of SNF beds per capita on hospital utilization is therefore expected to be stronger and more easily discerned than is the effect of ICF beds per capita.

The magnitude of the individual relationships is an empirical matter properly resolved by investigation. In this study, data limitations hamper this investigation. The MMACS data used for the study do not discriminate between SNF and ICF beds prior to 1985. Therefore only two years of data are available for this purpose. Furthermore, many beds are dually certified for SNF and ICF care. Without knowing how such beds are typically used, the effect of SNF and ICF beds cannot be separated completely. The regression equations estimated below contain three alternative specifications including 1) nursing home beds per capita, 2) SNF beds per capita (including dually-certified beds) and 3) SNF beds per capita (excluding dually-certified beds).

Empirical Results

Tables 5.1 through 5.3 present cross-section regression estimates of the log-odds of admission, the log of length of stay and the log-odds of rehospitalization within 30 days of hospital discharge in U.S. counties in 1985. Models were estimated separately for the aged Medicare population as a whole and also for those over the age of 85. As a result of the logarithmic specification, those counties lacking certified nursing home beds were eliminated from specifications [1] and [4]; those lacking certified SNF beds were eliminated from specifications [2] and [5]. (The composition of the dropped counties has not been investigated. In all likelihood, the counties included in specifications [2] and [5] are somewhat more urban in character than the 2498 counties that simply contained a nursing home bed of any kind. These counties themselves are probably more urban than the entire population of U.S. counties.)[27]

Hospital admission rates among the aged population as a whole are, as Table 5.1 shows, generally higher in counties with greater numbers of nursing home beds. Indeed, the positive relationship

[27] Fewer than one third of U.S. counties (945) contained nursing home beds that were certified for SNF but not for ICF care. The differences of specifications [3] and [6] from the others almost certainly reflect the character of these areas rather than the effects of discriminating SNF-only from SNF/ICF beds in the regression.

between admission rates and nursing home beds is stronger and more consistently seen than is the relationship between admission rates and the number of hospital beds in a county.

Among the 85+ Medicare population, there is evidence that nursing home beds do reduce the likelihood of hospital admission. There is, however, no evidence that SNF beds are more effective in deterring hospital admissions than ICF beds.

Five of the six specifications indicate that as the aged Medicare population of a county grows, holding constant the total county population, the odds of hospital admission fall. Furthermore, as the 85+ Medicare population increases, the odds of admission for this particular group decline as well. Additional evidence that this is a real phenomenon and not a statistical artifact or data error is provided by Table 5.2, which indicates higher average lengths of inpatient stays in counties with higher Medicare populations (and holding constant the total population). Greater average lengths of stay would be expected if usual medical practice in these counties required a higher level of illness severity in order for a physician to recommend hospitalization. This would naturally result in higher average lengths of stay in such counties.

Table 5.2 shows that counties with greater numbers of nursing home beds do tend to exhibit somewhat shorter average lengths of inpatient hospital stays than other counties, for a given Medicare population, as previously found by Kenney and Holahan (1990). The usual explanation, as noted earlier, is that greater access to nursing home beds, as gauged by the number of beds for a given elderly population, reduces the number of hospital days allocated to "waiting" for a nursing home bed by some functionally-impaired beneficiaries.

Additional nursing home beds apparently do not reduce the probability of rehospitalization within 30 days of discharge and may indeed increase the likelihood of a rehospitalization. The positive cross-section relationship is especially evident among the population of beneficiaries aged 85 and over. Once again, there appears to be a strong and statistically significant negative relationship between the size of a county's Medicare population and the probability of rehospitalization, similar to the result for admissions. This negative relationship is particularly evident for the 85+ population.

Estimates of the so-called "fixed-effects" models of hospital admission, length of stay, and readmission are shown in Tables 5.4 through 5.6. These are analogous to the model specified in equation (5.7) and include the years 1981, 1983, and 1985. Because SNF and ICF beds were not counted separately for 1981 and 1983, only those specifications involving total nursing home beds could be estimated in fixed-effect form. Notice that indicator variables that are unchanging over time within a given county (URBAN, NORTH CENTRAL, etc.) have been omitted since these are incorporated in the county-specific intercept (not reported).

The fixed-effect models which, as noted earlier, normally offer better protection against bias due to omitted variables, provide no evidence that nursing home beds reduce the rate of hospitalization. In urban areas, added nursing home beds appear to *increase* the rate of hospitalization (especially among beneficiaries aged 85 and over) as can be seen in specifications [21] and [24]. The estimated effect of an increase in nursing home beds on the odds of hospitalization in urban areas actually exceeds that of an increase in hospital beds. At present, there is no clear explanation for this result. Also of interest in Table 5.4 is the striking negative relationship between the size of a county's beneficiary population (holding total county population constant) and the odds of hospitalization. Specification [24] suggests that a one percent increase in the number of beneficiaries aged 85 and over in a county reduces the odds of hospitalization among this group by over two percent. Increases in the total county population (holding the number of aged beneficiaries constant) tend to increase the rate of hospitalization for Medicare beneficiaries, suggesting that the rate of Medicare hospitalization in a county is inversely related to the *share* of beneficiaries in the total population.

The fixed-effect estimates of the influence of nursing home beds on average length of stay, shown in Table 5.5, are very close to their cross-section counterparts shown in Table 5.2 (specifications [7] and [10]). Nursing home beds tend to reduce average length of stay for all aged beneficiaries and, to a slightly greater extent, for beneficiaries aged 85 and over as well. Increases in hospital beds tend to raise the average length of stay; this result is substantially stronger (roughly triple the size) than was indicated by the cross-section regressions in Table 5.2. Increases in the beneficiary population tend to *reduce* average length of stay, an unexpected result given the negative relation between beneficiary population and the hospital admission rate. One would expect the lower admission rate in counties with large beneficiary populations to result in increased patient severity (since the most ill would always be admitted) and hence increased length of stay. This does not seem to be the case.

Finally, as shown in Table 5.6, increases in nursing home beds do not appear to affect the odds of hospital readmission to a statistically significant degree. The *positive* effect, as estimated with cross-section data, may therefore be a misleading indicator of the overall effect. For all aged beneficiaries, the effect of a one percent increase in their population was a striking increase of nearly five percent in the odds of hospital readmission. While this result is consistent with the negative effect of beneficiary population on average length of stay, no such result is seen among the beneficiaries aged 85 and over.

Table 5.2
Minimum Logit Chi-Square Estimates of Medicare Admission Rates: 1985

	All Aged			Aged 85+		
	[1]	[2]	[3]	[4]	[5]	[6]
Intercept	-2.730 (-24.4)	-1.354 (-11.0)	-1.18 (-6.8)	-1.339 (-7.5)	-1.348 (-6.5)	-0.27 (-1.0)
log(Aged Benef)	0.071 (1.2)	-0.478 (-7.9)	-0.659 (-7.0)	-0.297 (-3.2)	-0.230 (-2.2)	-0.37 (-2.6)
log(Benef 80-84)	-0.110 (-2.2)	0.306 (5.1)	0.509 (5.1)	0.167 (2.1)	0.109 (1.1)	0.37 (2.4)
log(Benef 85+)	0.031 (0.8)	-0.058 (-1.5)	0.012 (0.2)	-0.101 (-1.8)	-0.150 (-2.3)	-0.20 (-1.9)
URBAN	-0.132 (-5.3)	-0.098 (-4.7)	-0.075 (-3.1)	-0.062 (-1.6)	-0.077 (-2.1)	0.01 (0.4)
log(population)	0.017 (0.8)	0.076 (3.6)	0.055 (1.6)	0.099 (5.4)	0.130 (3.5)	-0.04 (-0.7)
log(hospital beds)	-0.046 (-4.3)	0.022 (2.3)	-0.009 (-0.6)	0.089 (5.4)	0.077 (4.3)	0.06 (2.3)
log(NH beds)	0.023 (1.7)	0.022 (1.6)	0.053 (2.9)	-0.041 (-2.1)	-0.059 (-2.5)	0.05 (1.9)
log(SNF beds)		0.046 (5.6)			-0.004 (-0.3)	
log(SNF-only beds)			0.004 (0.4)			-0.004 (-0.3)
NORTH CENTRAL	0.007 (0.2)	-0.076 (-2.3)	-0.128 (-3.7)	-0.075 (-1.1)	-0.085 (-1.4)	-0.25 (-4.4)
SOUTH	0.110 (2.7)	0.057 (1.8)	0.042 (1.3)	-0.007 (-0.1)	-0.053 (-0.9)	-0.10 (-1.8)
WEST	-0.107 (-2.5)	-0.255 (-7.3)	-0.121 (-2.9)	-0.256 (-3.8)	-0.371 (-5.8)	-0.13 (-1.9)
R^2	0.09	0.26	0.21	0.09	0.12	0.12
N	2498	1834	945	2498	1834	945

Note: t-statistics appear in parentheses. Sample sizes represent the number of counties used in the analysis.

Table 5.3
OLS Estimates of Medicare Length of Stay: 1985

Dep. Var: log(Medicare hospital days/Medicare hospital admissions)

	All Aged			Aged 85+		
	[7]	[8]	[9]	[10]	[11]	[12]
Intercept	1.502 (27.7)	1.324 (17.9)	1.464 (15.1)	1.378 (14.8)	1.269 (10.9)	1.441 (9.0)
log(Aged Benef)	0.041 (1.4)	0.113 (3.1)	0.050 (1.0)	0.038 (0.8)	0.173 (3.0)	-0.037 (-0.4)
log(Benef 80-84)	-0.052 (-1.7)	-0.153 (-4.3)	-0.111 (-1.8)	-0.126 (-2.4)	-0.237 (-4.2)	-0.051 (-0.5)
log(Benef 85+)	0.034 (1.8)	0.071 (3.0)	0.058 (1.5)	0.125 (3.7)	0.141 (3.8)	0.055 (0.9)
URBAN	0.020 (2.5)	0.012 (1.0)	0.019 (1.7)	0.007 (0.5)	0.040 (2.0)	-0.006 (-0.3)
log(population)	0.057 (6.0)	0.065 (5.2)	0.086 (5.1)	0.085 (5.2)	0.026 (1.3)	0.149 (5.3)
log(hospital beds)	0.015 (3.2)	-0.016 (-2.5)	0.024 (3.0)	0.013 (1.7)	0.006 (0.6)	0.021 (1.6)
log(NH beds)	-0.039 (-6.8)	-0.007 (-0.9)	-0.065 (-6.9)	-0.059 (-6.0)	-0.004 (-0.3)	-0.088 (-5.6)
log(SNF beds)		-0.023 (-4.7)			-0.021 (-2.6)	
log(SNF-only beds)			0.011 (2.8)			0.020 (3.1)
NORTH CENTRAL	-0.186 (-18.4)	-0.189 (-9.6)	-0.229 (-16.5)	-0.295 (-17.0)	-0.301 (-8.9)	-0.383 (-16.7)
SOUTH	-0.187 (-18.6)	-0.198 (-10.1)	-0.228 (-17.1)	-0.257 (-14.9)	-0.226 (-6.7)	-0.347 (-15.7)
WEST	-0.379 (-32.5)	-0.366 (-17.4)	-0.469 (-28.2)	-0.520 (-26.0)	-0.477 (-13.3)	-0.642 (-23.3)
R^2	0.53	0.44	0.62	0.42	0.37	0.52
N	2498	1834	945	2498	1834	945

Note: t statistics appear in parentheses. Sample sizes represent the number of counties used in the analysis.

Table 5.4

Minimum Logit Chi-Square Estimates of Medicare Rehospitalization Rates: 1985

Dep. Var: log[rehosp rate/(1-rehosp rate)]

	All Aged			Aged 85+		
	[13]	[14]	[15]	[16]	[17]	[18]
Intercept	-0.749 (-6.9)	-1.100 (-7.5)	-1.173 (-6.3)	1.778 (10.8)	1.957 (10.2)	0.942 (3.2)
log(Aged Benef)	-0.197 (-3.5)	0.109 (1.5)	-0.193 (-1.9)	-0.372 (-4.3)	-0.170 (-1.7)	-0.138 (-0.9)
log(Benef 80-84)	0.029 (0.6)	-0.129 (-1.8)	0.370 (3.3)	0.108 (1.5)	0.564 (6.3)	0.448 (2.6)
log(Benef 85+)	-0.035 (-0.9)	-0.123 (-2.5)	-0.249 (-3.2)	-0.240 (5.5)	-0.661 (-10.6)	-0.549 (-4.5)
URBAN	-0.007 (-0.3)	-0.017 (-0.7)	-0.094 (3.6)	0.071 (1.9)	0.148 (4.2)	0.061 (1.4)
log(population)	0.020 (0.9)	-0.056 (-2.3)	0.010 (0.3)	0.010 (0.3)	-0.252 (-7.0)	-0.131 (-2.2)
log(hospital beds)	0.070 (6.5)	0.042 (3.3)	-0.020 (-1.3)	-0.056 (-3.8)	0.024 (1.4)	0.057 (2.1)
log(NH beds)	0.031 (2.2)	0.088 (5.3)	0.051 (2.5)	0.118 (6.6)	0.120 (5.4)	0.019 (0.6)
log(SNF beds)		-0.011 (-1.1)			0.031 (2.1)	
log(SNF-only beds)			-0.001 (-0.1)			0.011 (0.7)
NORTH CENTRAL	-0.079 (-1.9)	-0.070 (-1.8)	-0.083 (-2.2)	-0.173 (-2.6)	-0.190 (-3.0)	-0.075 (-1.1)
SOUTH	0.053 (1.3)	0.047 (1.2)	0.071 (1.9)	0.051 (0.8)	0.029 (0.5)	0.093 (1.5)
WEST	-0.006 (-0.1)	<0.0001 (0.01)	0.103	0.082 (1.2)	0.213 (3.3)	0.099 (1.3)
R^2	0.21	0.16	0.13	0.55	0.58	0.29
N	2498	1834	945	2498	1834	945

Note: t statistics appear in parentheses. Sample sizes represent the number of counties used in the analysis.

Table 5.5
Minimum Logit Chi-Square Estimates of Medicare Admission Rates:
Fixed Effect Model for 1981, 1983 and 1985

	All Aged			Aged 85+		
	[19] ALL	[20] RURAL	[21] URBAN	[22] ALL	[23] RURAL	[24] URBAN
log(Aged Benef)	0.590	0.673	-0.960	1.311	1.395	0.676
	(3.44)	(3.35)	(-2.51)	(4.18)	(3.78)	(1.11)
log(Benef 80-84)	-0.928	-0.938	-0.482	-0.235	-0.236	-0.331
	(-11.2)	(-9.84)	(-2.13)	(-1.54)	(-1.34)	(-0.90)
log(Benef 85+)	-1.678	-1.695	-0.899	-2.102	-2.098	-2.067
	(-16.5)	(-14.5)	(-3.68)	(-11.4)	(-9.85)	(-5.14)
log(population)	0.507	0.525	0.369	0.340	0.348	0.489
	(5.27)	(4.59)	(2.69)	(1.97)	(1.69)	(2.22)
log(hospital beds)	-0.038	-0.444	0.130	0.084	0.083	0.157
	(-1.54)	(-1.53)	(2.95)	(1.89)	(1.61)	(2.04)
log(NH beds)	0.007	0.003	0.057	0.039	0.013	0.249
	(0.34)	(0.14)	(2.55)	(1.08)	(0.30)	(7.14)
R^2	0.97	0.96	0.99	0.91	0.90	0.97
N	7423	5523	1900	7419	5519	1900

Note: t-statistics appear in parentheses. Sample sizes (N) represent the number of county-years of data used in the analysis.

Table 5.6
Estimates of Medicare Hospital Length of Stay:
Fixed Effect Model for 1981, 1983 and 1985

Dep. Var.: Log(Medicare Hospital Inpatient Days/Medicare Hospital Admissions)

	All Aged			Aged 85+		
	[25] ALL	[26] RURAL	[27] URBAN	[28] ALL	[29] RURAL	[30] URBAN
log(Aged Benef)	-0.275	-0.462	-0.471	0.356	-0.091	-0.034
	(-2.11)	(-2.97	(-1.85)	(1.63)	(-0.32)	(-0.09)
log(Benef 80-84)	0.027	-0.403	1.085	-0.241	-0.842	1.279
	(0.34)	(-4.74)	(5.92)	(-1.78)	(-5.36)	(4.79)
log(Benef 85+)	-1.521	-1.074	-2.290	-2.346	-1.774	-3.240
	(-19.1)	(-12.3)	(-14.0)	(-17.8)	(-11.0)	(-13.7)
log(population)	0.735	0.754	0.738	0.719	1.071	0.556
	(15.3)	(11.1)	(9.19)	(8.81)	(8.31)	(4.70)
log(hospital beds)	0.117	0.067	0.176	0.162	0.069	0.274
	(7.29)	(3.90)	(5.18)	(6.06)	(2.16)	(5.65)
log(NH beds)	-0.045	-0.048	-0.041	-0.075	-0.070	-0.778
	(-5.28)	(-4.89)	(-2.45)	(-4.08)	(-3.74)	(-3.13)
R^2	0.91	0.80	0.93	0.85	0.69	0.91
N	7423	5523	1900	7419	5519	1900

Note: t-statistics appear in parentheses. Sample sizes (N) represent the number of county-years of data used in the analysis. Observations are weighted by (the square root of) the number of Medicare hospital admissions.

Table 5.7
Minimum Logit Chi-Square Estimates of Medicare Rehospitalization Rates:
Fixed Effect Model for 1981, 1983 and 1985

Dependent Var.: log(Readmission Rate/[1-Readmission Rate])

	All Aged			Aged 85+		
	[31] ALL	[32] RURAL	[33] URBAN	[34] ALL	[35] RURAL	[36] URBAN
log(Aged Benef)	-0.070	0.014	-0.459	1.308	1.824	0.129
	(-0.34)	(0.05)	(-1.31)	(1.90)	(1.75)	(0.15)
log(Benef 80-84)	-0.368	-0.291	-0.624	-0.515	-0.751	-0.294
	(-2.85)	(-1.91)	(-2.48)	(-1.20)	(-1.33)	(-0.46)
log(Benef 85+)	0.368	-0.083	1.102	-0.940	-1.747	0.253
	(2.93)	(-0.53)	(4.89)	(-2.26)	(-3.00)	(0.45)
log(population)	-0.282	0.023	-0.463	-0.078	0.480	-0.458
	(-3.72)	(0.19)	(-4.19)	(-0.30)	(1.04)	(-1.64)
log(hospital beds)	-0.044	-0.027	-0.065	0.005	-0.004	0.018
	(-1.71)	(-0.88)	(-1.40)	(0.06)	(-0.04)	(0.16)
log(NH beds)	0.041	0.015	0.070	0.061	0.077	0.043
	(3.03)	(0.89)	(3.04)	(1.33)	(1.14)	(0.72)
R^2	0.99	0.98	0.99	0.	0.78	0.98
N	7423	5523	1900	7419	5519	1900

Note: t-statistics appear in parentheses. Sample sizes (N) represent the number of county-years of data used in the analysis.

Discussion

The main hypothesis set forth in Chapter 2 was that an increase in the availability of nursing home beds would tend to reduce the use of inpatient care by aged Medicare beneficiaries, other things constant. This hypothesis was *not* supported by the analysis of county-level Medicare hospital utilization in the years from 1981 through 1986. While increased availability of nursing home beds does tend to reduce the average length of hospital stays, it also appears to stimulate rather than reduce hospital admissions for aged beneficiaries living in urban areas. Moreover, the increase in the probability of hospital admission associated with the addition of nursing home beds is most pronounced among the oldest beneficiaries, those most likely to use nursing home care. Whether this result should be taken at face value or whether it should be regarded as indicative of some shortcoming in the analysis is nearly impossible to determine at present. Had the analysis simply failed to find the hypothesized negative relation, then abandonment of the hypothesis would be a straightforward matter of facing the evidence. However, the results suggest that the relation between nursing home beds and hospital use is *positive* even after controlling for persistent county-specific effects. Lacking some persuasive mechanism whereby an increase in the number of nursing home beds could by itself enhance the use of hospital care, the most likely explanation for the results is the failure of one or more of the assumptions underlying the analysis.

The weakest underpinning of the analysis is, in my opinion, the assumption that access to nursing home care is always positively related to the number of nursing home beds relative to the elderly population. The nature of this assumption and of the consequences of alternative assumptions may be seen in the following two figures. Consider the supply and demand configuration of Figure 5.1. Notice that demand is assumed to be stable (given the values of other variables held constant in the regression). The supply of beds, represented here as vertical for convenience only, is assumed to change exogenously over time. If the demand curve as presented here takes Medicaid eligibility and payment policy as given, then the intersection of supply and demand will not determine market price. but rather shows, in equilibrium, the degree of "sacrifice" necessary to secure a nursing home bed. This sacrifice, represented by values of s in Figure 5.1, is thus inversely related to access. As Figure 5.1 shows, under our assumptions, increases in the number of nursing home beds does indeed result in a decrease in s and so an increase in access.

Suppose, however, that the actual situation in most areas is the one depicted in Figure 5.2. If demand, shown here as perfectly inelastic for convenience, varies from time to time in ways that are *not* captured by the regressors, and if supply is stable, then changes in the observed quantity of beds in an area may result from changes in demand, not in "availability" or supply.[28] The increase in nursing home beds brought about by these shifts in demand may be associated with an increase in s and hence a *reduction* in access.

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[28] Since the suppliers of nursing home care do not themselves receive a payment of s for the provision of a bed-day, changes in s brought about by changes in demand should probably regarded as impinging on the regulatory apparatus that licenses or certifies new nursing home beds.

It is even possible that changes in demand for nursing home care may be (positively) correlated with changes in demand for inpatient admissions, so that the average severity of inpatients could be correlated with changes in observed nursing home beds. This could mean that nursing home bed availability is not itself related to hospital use even though it would appear to be negatively related to average length of stay as found here and elsewhere.

Admittedly, the representation of changes in nursing home beds as driven primarily by unobserved changes in demand is hard to accept in the absence of other evidence. The resolution of the roles of supply and demand factors in producing changes in numbers of beds must await later research. Such investigation, combined with further efforts to delineate the actual relation between hospital and nursing home use offer the best prospect for understanding the results seen here.

A Competitive Nursing Home Market with Fixed Supply

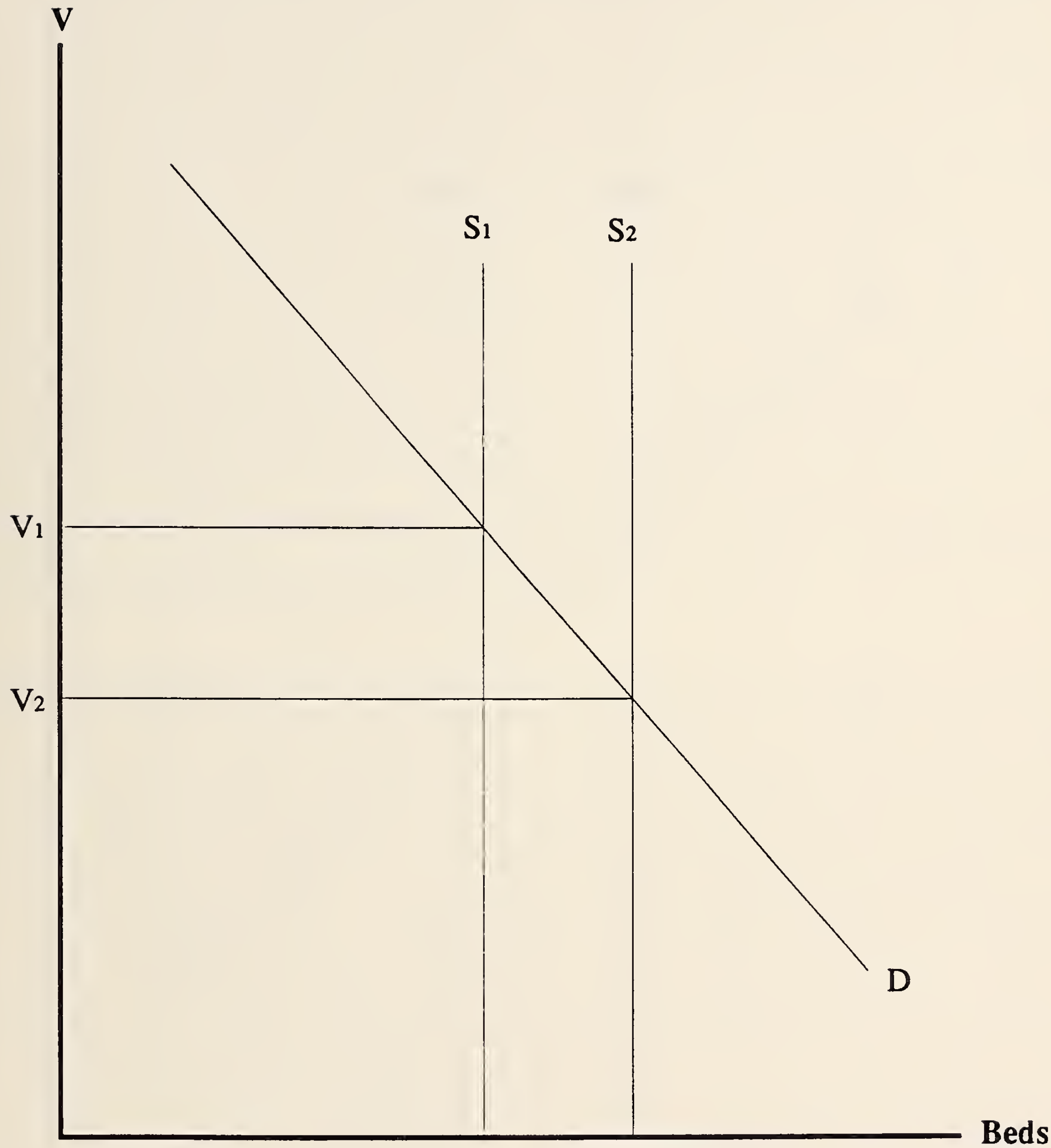

Figure 5.1

A Competitive Nursing Home Market with Fixed Demand

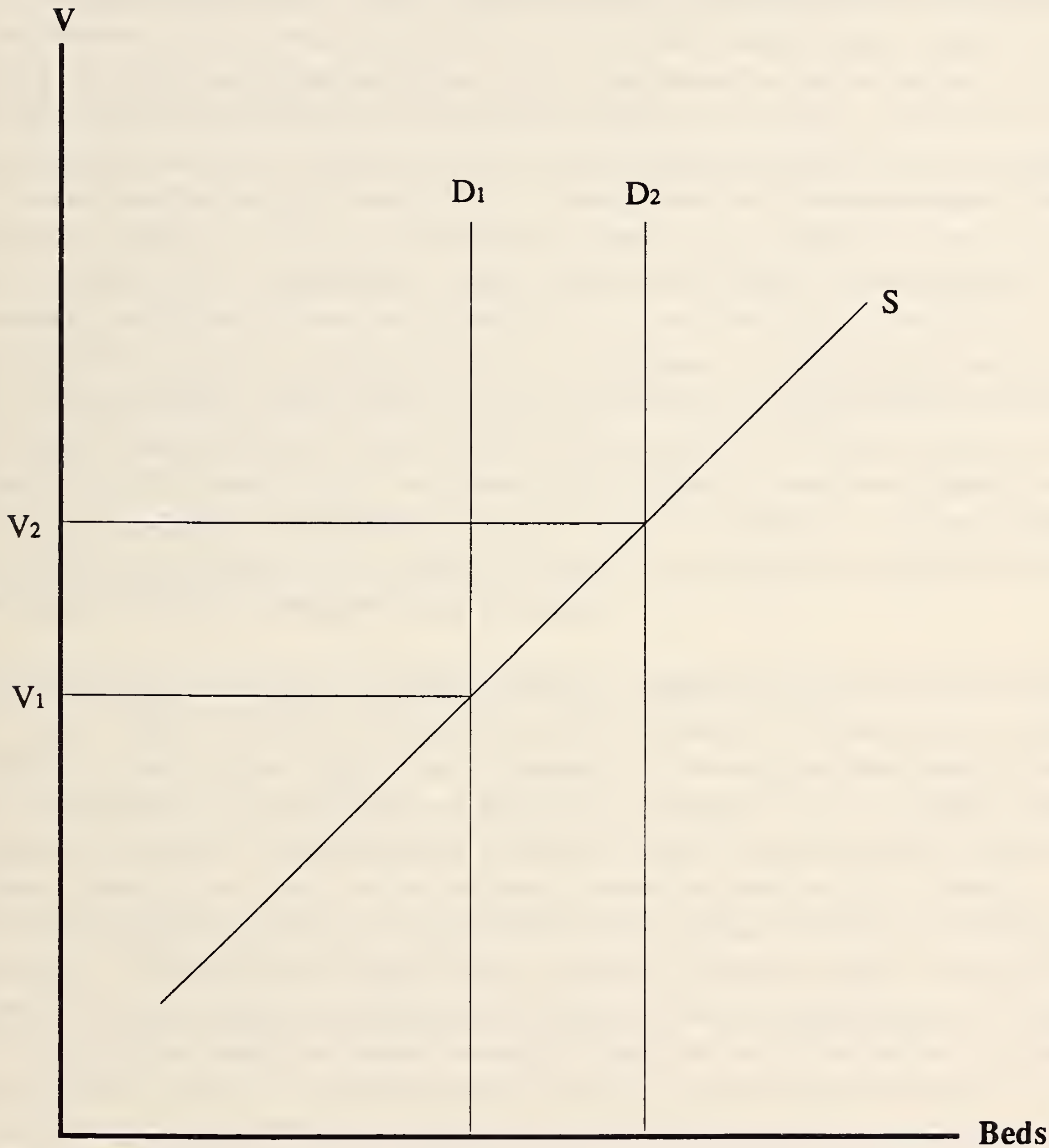

Figure 5.2

Chapter 6

Conclusion

The argument for a negative relation between availability of nursing home beds and the rate of hospitalization among Medicare beneficiaries in a locality rests on the assertion that beneficiaries will, in accordance with the law of demand, tend to increase their use of forms of care that become cheaper or easier to use and will therefore reduce their use of some other forms of care whose ease of use has not changed. The extent to which use of particular other forms of care declines will depend on the degree to which the two forms of care substitute for each other. Because only a tiny fraction of patients admitted to acute-care hospitals receive care that could be provided at a similar level in a nursing home, any hypothesized negative relationship between the availability of nursing home care and hospital admissions per elderly person must surely be quite small in absolute value. Nevertheless a negative relation was expected for two reasons. First, in communities in which nursing home care is especially scarce, some individuals may be admitted to a hospital for precautionary reasons that might otherwise have led a physician to recommend placement in a nursing home. Such precautionary admissions may not occur (at least to the same extent) in other communities with easier access to nursing home care, reducing slightly their admission rates. Second, nursing home residents themselves may be somewhat less likely to be admitted to a hospital than are otherwise identical community residents due to the higher level of monitoring in the nursing home environment. An increase in the number of individuals in nursing homes *which results from an increase in the availability of beds* could therefore reduce slightly the rate of hospitalization among the elderly.

The empirical analysis conducted in this report provides no evidence that substitution of the sort described above occurs. There is, further, no evidence that increased numbers of nursing home beds reduces the probability of rehospitalization within 30 days of discharge. At the same time, these results do indicate, in fairly robust fashion, that nursing home care can substitute for *days* of care in a hospital. Increases in nursing home beds tend to reduce the duration of Medicare hospital stays *ceteris paribus* and this reduction is greater in absolute value among the very old than it is among the Medicare aged population as a whole. I have already suggested that the use of nursing home beds as a measure of access or availability may be inappropriate. The length-of-stay results, however, do behave as expected under the presumption that the number of nursing home beds per elderly person is a measure of access or opportunity cost. It may be that the nursing home beds-hospital admission relationship is simply too weak to be detected with county level data such as these, which may for practical purposes mean simply that the effect does not exist. It may also be true that admission or readmission relationships are much more sensitive to the specification of the correct market area than is the length of stay relationship. The exploration of alternative areas remains a promising area for research. It must be stressed that the success of this research is largely a matter of conjecture and cannot be assured or even hinted at on the basis of results seen here.

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